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## RESEARCH REPORT

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# **The Environmental Costs of Coastal Reclamation in Metro Cebu, Philippines**

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This study assesses the environmental cost of a large coastal reclamation project in the Philippines. It was undertaken to find out whether such projects generate an overall loss or gain for society as a whole. Such assessments are rarely made for projects of this type. In the past, this has led to inappropriate and unnecessarily destructive development.

The study used a number of valuation methods to assess the Cordova Reclamation Project (CRP). This ambitious scheme - which has not yet been implemented - would reclaim almost 3,000 hectares of coastal area around the island of Mactan. The project's impact on fishing, shell-fish collection and tourism were assessed. So was the impact of the quarrying that would supply the rubble needed for the project's landfill.

The report finds that the environmental cost of the CRP would be about PHP3.3 billion (USD59.8 million). Almost 86% of this total environmental cost would be due to damages from landfill quarrying and damage to corals. Taking into account construction costs and the economic benefits the project would bring, this means that the reclamation scheme would result in an economic cost to society of over PHP18.4 billion (USD335 million).

Given these findings, the report concludes that the project should be reassessed and that steps should be taken to reduce its environmental impact. Options for how this can be done are outlined. The report also suggests that other development strategies, such as eco-tourism, should also be considered. In general it highlights the importance of proper environmental impact assessment and costing for coherent policy development.

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Lourdes O. Montenegro, Annie G. Diola and Elizabeth M. Remedio

March 2005

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EEPSEA was established in May 1993 to support research and training in environmental and resource economics. Its objective is to enhance local capacity to undertake the economic analysis of environmental problems and policies. It uses a networking approach, involving courses, meetings, technical support, and access to literature and opportunities for comparative research. Member countries are Thailand, Malaysia, Indonesia, the Philippines, Vietnam, Cambodia, Lao PDR, China, Papua New Guinea and Sri Lanka.

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# **THE ENVIRONMENTAL COSTS OF COASTAL RECLAMATION IN METRO CEBU, PHILIPPINES**

**Lourdes O. Montenegro, Annie G. Diola and Elizabeth M. Remedio**

## **EXECUTIVE SUMMARY**

Coastal land reclamation – the process of creating new land by covering up coastal areas with landfill – is becoming a popular way of expanding the space available for economic activity in East and Southeast Asia. However, this activity comes at a price in terms of its adverse impact on the environment. Environmental costs mainly arise from the loss of coastal resources (and the ecosystem goods and services they provide) and from the adverse impacts of landfill quarrying. However, these environmental costs are often not valued nor explicitly considered when the feasibility of such reclamation projects are evaluated. As a result, there is often no clear picture of the trade-offs involved.

This study examines the case of the Cordova Reclamation Project (CRP), the largest proposed coastal reclamation project in the Philippines. The environmental costs arising from this project were estimated to have a net present value of almost Php 3.3 billion or US\$ 59.8 million. This represents about 13 % of the total costs of the reclamation development itself. Environmental costs were estimated from the value of four major environmental impacts: (1) the loss of on-site fisheries; (2) the loss of reef gleaning; (3) the loss of potential recreational benefits from the affected coral reef; and (4) the environmental damage from landfill quarrying.

The largest contributing factors to the project's environmental costs were its adverse impacts on coral reefs and the environmental impacts of its quarrying work. The costs associated with these issues were estimated to be approximately US\$ 31 million and US\$ 19 million, respectively. The value of on-site fishery and reef gleaning losses was estimated at over US\$ 7 million. While this does not appear large, in comparison with the costs associated with coral and quarrying damage, it nevertheless constitutes a significant livelihood loss for thousands of Cordova residents. This is especially true for barangays on the south and southeastern coast, since this is where the bulk of households engaged in fishing and gleaning activities are found.

The total environmental cost estimated in this study is to be considered a lower bound figure since it leaves out non-use values. It also ignores the effects of other reclamation construction impacts such as any temporary increase in dust and noise pollution.

A comparison of the costs arising from the CRP (including environmental costs) with projected economic benefits – in the form of profits earned by the industrial and commercial firms that may locate on the new land – yields negative net present values, even for the most optimistic projections of benefit flows. The economic loss to society, if the project was undertaken, was estimated to range from US\$ 335 million to US\$ 404 million (net present value in a 30-year period at an 8 % discount rate).

## **1.0 INTRODUCTION**

### **1.1 The Coastal Reclamation Experience in East Asia**

Coastal reclamation is an increasingly popular response to the perceived need for more space in many East and Southeast Asian cities. Singapore, Hongkong and many coastal cities in Japan, China, Taiwan, and South Korea have changed the outlines of their coastlines for a variety of purposes – industrial, institutional and even agricultural. For example, it has been estimated that South Korea has reclaimed more than 62,000 hectares of its coastal area since the Second World War. It adopted a National Reclamation Master Plan in the 1980s in order to reclaim even more (Hwang 1999; Moores & Bräunlich 1999). In Hong Kong, about a tenth of the country's developed area is reclaimed land and more is being planned, including one project that will provide space for a Disney theme park (Jiao 2000).

While providing more land, these projects are, however, not without environmental trade-offs. The 40,100 hectare Saemankeum project in the southwest of South Korea – currently the world's largest ongoing reclamation project – will destroy what is considered to be South Korea's most important wetland areas. This wetland used to comprise an extensive intertidal flat which provided a habitat for more than 100,000 birds belonging to several dozen species; 23 of these species were found in the area in globally significant numbers (Moores & Bräunlich 1999). The Singaporean government recently had to contend with an analogous trade-off when it approved a plan to reclaim more than 3,000 hectares of land around the islands of Tekong and Pulau Ubin. It had to change its plans and temporarily forego the reclamation work at Pulau Ubin due to concerns over the destruction of the island's rich coastal biodiversity (Straits Times 2002).

### **1.2 Urbanization and the Drive for Coastal Reclamation in Metro Cebu**

Like other East and Southeast Asian cities, Metro Cebu, the Philippines' second largest metropolis<sup>1</sup>, is also turning to coastal reclamation to expand its urban space. Indeed, the first major reclamation work took place in 1964 when the 160 hectare North Reclamation Area was completed. Metro Cebu is located in the middle of the Visayan Islands, which lie in the center of the Philippine archipelago (see map in Appendix B). The core of this growing urban center is concentrated in a narrow strip of coastal lowland which is bounded by coastal foothills (Hafner 2002). In 1990, the total population of this metropolis was 1.3 million and the population density for the lowland area was greater than 17,000 persons per km<sup>2</sup>. (Flieger 1994). The population had grown to 1.6 million by 2000 (National Statistics and Census Office 2000). At the time provincial and city government units likened the geographical lay out of Cebu to that of Hong Kong and argued that space was at a premium and that coastal reclamation was necessary. Development master plans broadly envisioned a Hong Kong-style of urban development where economic growth is driven by tourism and manufacturing for exports.

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<sup>1</sup> The Philippines' National Economic and Development Authority (NEDA) defines this metropolitan area as being composed of the cities of Cebu, Mandaue, Lapulapu and Talisay, as well as the municipalities of Minglanilla, Naga, Compostela, Liloan, Cordova, and Consolacion (refer to Figure 1). These cities and municipalities lie within an area which has a radius of about 25 kilometres.

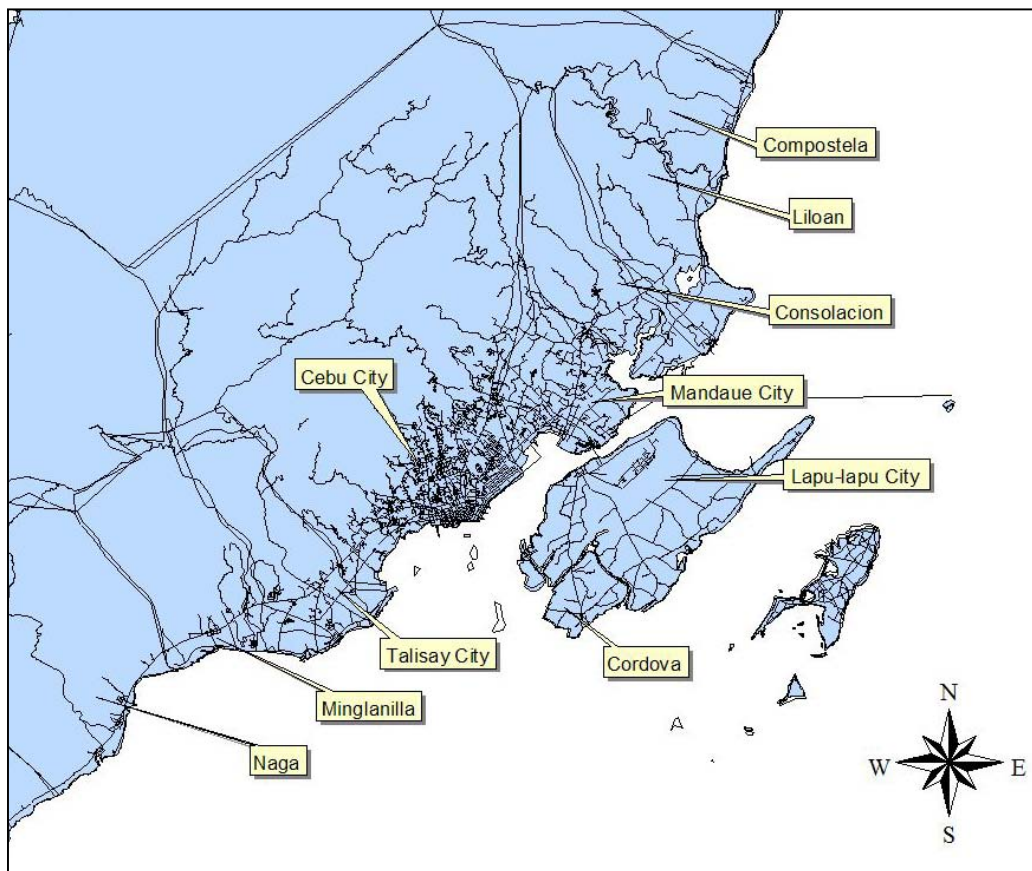


Figure 1. Component Towns and Cities of Metro Cebu

In the late 1980's and early 1990's, Metro Cebu experienced rapid economic growth. This led to a boom in export production and real estate development. Along with this boom came increased speculative land buying and sharp increases in urban land prices (Sajor 2001). The high cost of land acquisition was another of the contributing factors that encouraged local government units and private investors to pursue a policy of coastal reclamation, since this appeared to be a relatively cheap way of acquiring additional industrial and commercial land. Hence, the real estate boom was accompanied by reclamation activity.

The construction of new reclamation sites commenced in the early 1990's, with the development of the Mactan Export Processing Zone (MEPZ). More than 70 firms, of which more than half are Japanese, currently operate in MEPZ. They employ about 27,000 people and pay out some Php 1.5 billion (US\$ 27 million) annually in salaries and wages (<http://www.philexport.org>). The perceived successes of the MEPZ in attracting foreign direct investment to the region has led to a proposal to reclaim the zone's nearby tidal flat to make way for more industrial space (University of San Carlos 1991).

As part of the third phase of the Metro Cebu Development Project, a 300-hectare reclamation project was constructed along the southern coast of Cebu City during the latter half of the 1990's. It was completed in 2001. This project, which was known as the Cebu South Reclamation Project (CSR), was funded by a loan from the Japan Bank for International Cooperation (JBIC). It covers 14 kilometers of coastline and

required more than 13 million cubic meters of landfill. This landfill was quarried from the upland areas of Cebu and neighboring islands. The project's official rationale was to provide more space to accommodate export-oriented industry and foreign direct investment (Katahira and Engineers International 1993). Currently, there are five existing reclamation areas in Metro Cebu with a total area of more than 700 hectares.

Other cities and municipalities in Metro Cebu also propose to undertake reclamation projects. One of these is the Municipality of Cordova which proposes to reclaim almost 3,000 hectares of its coastal area; if carried out this will be one of the largest coastal reclamation projects in Southeast Asia.

### **1.3 Environmental Impacts of Coastal Reclamation**

Coastal reclamation, especially as it is practiced in the Philippines and in other parts of East Asia, affects both coastal and upland environments. Its most apparent and well-documented environmental impact is the adverse effect it has on the coastal environment. It covers up and destroys intertidal reefs areas and the marine environment above them. Associated dredging operations can also damage adjacent corals.

A number of recent studies have shown that coastal land reclamation is one of the major culprits responsible for the loss of intertidal flats and other coastal resources in East and Southeast Asia (Kawabe 1998 and Hwang 1999). Intertidal reef areas are often the first to be targeted for reclamation because they are, from an engineering perspective, convenient and cost-effective to landfill. A case in point is Japan's Tokyo Bay where massive reclamation projects have been responsible for a decrease in the total area of intertidal flats of more than 90%. The extent of the problem in Japan is such that several artificial intertidal flats (also known as tidelands) have been constructed for recreational purposes. They are also being considered for pollution control (Kawabe 1998).

Intertidal reef areas are unique and highly productive ecosystems that provide a habitat for a vast variety of creatures that include, among others, shellfish, fish, and waterfowl. These areas may be categorized as marine wetlands<sup>2</sup>. Like all wetlands, they also provide various valuable ecosystem services such as: (1) shoreline protection and storm damage buffer zones; (2) fisheries and fish nurseries; (3) nutrient cycling and storage and related pollution control; (4) commercial goods output; and (5) extended food web control (Pearce and Turner 1990). Many of the ecological goods and services that are provided by such wetlands are, however, often non-marketable and may take the form of a public good. In this case people's preferences for them, as reflected by the choices they make (i.e. their 'willingness to pay' in terms of other goods), do not show up in the market. Such goods and services often do not have a market price and their values are therefore underappreciated.

Coral reef ecosystems are also readily affected by reclamation activity since corals are very sensitive to any increase in the concentration of suspended particles in

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<sup>2</sup> The 1971 Ramsar Convention on Wetlands of International Importance defines wetlands as: "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters...and may incorporate riparian and coastal zones adjacent to wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands."

the water they live in. Dredging activities related to reclamation work result in heavy siltation and also cause anoxic conditions in surrounding waters. This contributes to the smothering of corals. Considering that coral reefs take a very long period of time to recover and regenerate, this impact is usually thought of as permanent (University of San Carlos 1991).

Coral reefs rival tropical rainforests in terms of the amount of biological diversity they support. They are highly valuable ecosystems which provide a variety of goods and services. They are, for example, crucial in the maintenance of productivity in the fisheries sector. They are also admired for their beauty and often attract a variety of tourists and sports people. The Philippines sits within the so-called 'coral triangle' which is at the center of biodiversity in the marine tropics. Yet, its coral areas are highly threatened – less than a third can be classified as being in good or excellent condition (World Bank 2000).

The loss of intertidal flats and coral areas are among the major environmental costs of coastal reclamation. However, these costs are not just limited to those caused by impacts to coastal and marine ecosystems. In many cases, coastal reclamation projects require significant quarrying activity to take place. Millions of cubic meters of quarried landfill are often necessary. In the case of reclamation projects in Metro Cebu, this has often entailed quarrying upland areas.

As pointed out by Matsuoka (1994) the costs of reclamation activity stem not only from the opportunity costs associated with the loss of sea surface area, but also include costs associated with landfill gathering, the destruction of corals by dredging operations, and any temporary increase in noise and dust pollution caused by construction work. There are also costs that stem from the additional air and marine pollution produced by the human activity that accompanies the land creation work. Following Matsuoka (1994), Table 1 summarizes and categorizes the various environmental impacts and environmental costs of reclamation activity.

Table 1. Summary of Reclamation Impacts and External Costs

Category of Impact	Associated Environmental Costs
1) Loss of sea surface area	<ul style="list-style-type: none"> <li>▪ Lost value from ecosystem goods and services provided by intertidal reef areas</li> <li>▪ Damage to adjacent corals</li> </ul>
2) Impacts of building work	<ul style="list-style-type: none"> <li>▪ External costs of landfill quarrying</li> <li>▪ Increase in noise pollution and other temporary effects</li> </ul>
3) Impacts of additional human activity on newly created land	<ul style="list-style-type: none"> <li>▪ Additional air and marine pollution</li> </ul>

The official rationale for most development decisions, including decisions to undertake reclamation projects, is often economic. If the environmental cost of reclamation activity is not taken into account, the project appraisal process may tend to overstate the economic benefits of the reclamation project and understate the costs, making it appear desirable from an economic welfare perspective. The failure to

measure and account for environmental costs can therefore result in inappropriate policy. It can also distort development and investment decisions and lead to the unnecessarily depletion, degradation and over-exploitation of natural resources (Barbier 1998; Goulder and Kennedy 1998).

This raises a number of important questions: Do reclamation projects give positive net benefits to society as a whole? How large are the environmental costs involved and do they outweigh the expected economic benefits? Unfortunately, it is clear that in the drive to reclaim land, not much of an attempt has been made to systematically answer these questions. There is therefore no clear picture of the environmental trade-offs associated with coastal reclamation.

To help address this information short-fall, this study sought to determine the economic value of the major environmental costs of southeast Asia's largest proposed reclamation project in the Municipality of Cordova, Mactan Island. The environmental costs of this project were then added to its construction costs. The resulting overall costs were then compared with the project's expected economic benefits to determine whether it represents a socially beneficial development.

#### **1.4 Research Objectives**

The study aimed to investigate the environmental costs of coastal reclamation in Metro Cebu by examining the case of the proposed CRP.

Specifically, the study sought to:

- 1) Determine the economic value of the forgone net benefits from the coastal/marine ecosystem destroyed by reclamation activity.
- 2) Estimate the external costs from landfill gathering/quarrying in the uplands of Metro Cebu.
- 3) Compare the reclamation project's construction costs and environmental costs with projected economic benefits.
- 4) Draw policy inferences from this analysis to show the value of doing a cost-benefit study.

## 2.0 THE CORDOVA RECLAMATION PROJECT

### 2.1 The Setting: Cordova, Mactan Island, Central Philippines

The Municipality of Cordova is a town in Metro Cebu. It is located in the southeastern part of Mactan Island. It has a total land area of 846 hectares (or 8.46 km<sup>2</sup>) and is separated from the Mactan mainland during high tide by two narrow channels that reach in from the sea. The town has 13 barangays<sup>3</sup> of which only one is landlocked.

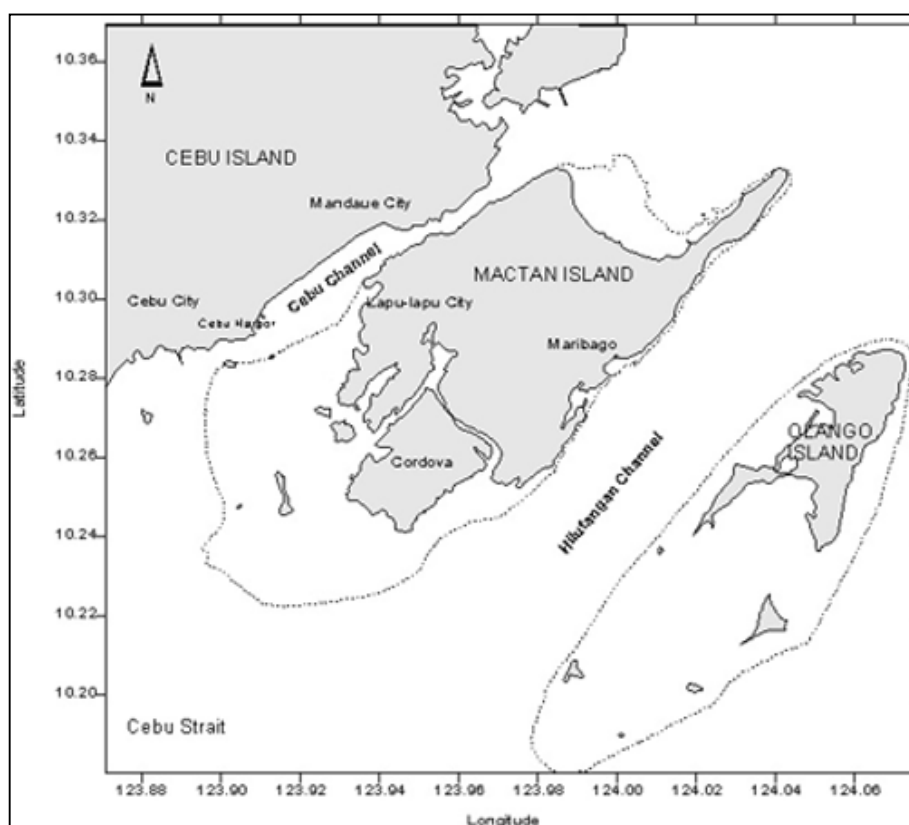


Figure 2. Location Map of the Municipality of Cordova

The town is endowed with considerable coastal resources and, as a result, an important portion of the local economy revolves around artisanal fishing and the harvesting or gleaning of marine products. According to the Department of Agriculture's Provincial Office, the town's 175 km<sup>2</sup> of municipal fisheries produced more than 800,000 metric tons of fish in 1990.<sup>4</sup>

Most of the fishing activity in the area is a small-scale family affair, usually concentrated on the intertidal flat and reef ledge. The intertidal flat within the

<sup>3</sup> The *barangay* is the smallest political and administrative unit in the Philippines and is equivalent to a village.

<sup>4</sup> It is not specified whether this amount represents fish harvested exclusively within Cordova waters and may therefore be an overestimate of the productivity of Cordova's coastal resources. The valuation of the fishery in this study was not based on this harvest estimate.

municipality's boundaries has an area of 17.4 km<sup>2</sup> and borders the town's south, southeastern and western coasts. It has a sandy-silty bottom that is interspersed with rock and coral rubble together with live coral fragments. During low tide, the upper littoral zone as well as other areas of the flat become bare and expose a shallow lagoon. Seagrasses prominently occupy the bottom of this extensive flat while a young successional mangrove community borders the coastline. This extends 50 to 100 meters from the shore (University of San Carlos 1998).

There are two islands within the jurisdiction of the municipality. One is Gapas Island. This is found off the southwestern coast and is located within the shallow lagoon mentioned above. The other, Gilutongan Island, is located across the channel facing the eastern coast. A 14-hectare marine sanctuary is located along the western side of Gilutongan Island. It is very popular among local and international tourists who visit for recreational diving and snorkeling. The reserve had more than 47,000 visitors in 2002. The sanctuary collected approximately Php 2 million in user fee revenue in 2002. This represents almost half of the municipal government budget for that year.

Among the ten component towns and cities of Metro Cebu, Cordova had the second highest population density of more than 4,000 persons per km<sup>2</sup> in 2000 (Municipality of Cordova 2002). The town has a population of 34,032. It has more than 6,000 households (NCSO 2000).



Plate 1. View of Cordova's Southwestern Coast at High Tide





Plate 2. View of Cordova's southeastern coast at high tide

## **2.2 Project Description and History**

As early as 1977, the Municipality of Cordova had entered into a contract with the Malayan Integrated Industries Corporation (MIIC), a Manila-based developer, for the reclamation of its foreshore area. This contract was approved by the Office of the President of the Philippines in May 1996. The private developer was to assume all costs relating to the construction and the resulting newly created land was to be shared between the developer and the local and national government (through the Office of the President – Public Estates Authority) 70/30 in favor of the developer. The project costs were estimated at Php 37.5 billion in 1997 prices (Malayan Integrated Industries 1997).

Originally, the local government unit (LGU) had proposed the reclamation of 1,600 hectares of the intertidal flat. In 1998, it revised the plans to effectively increase the proposed reclamation area to 2,707 hectares. This is larger than the total area of the intertidal flats within the municipality's boundaries (University of San Carlos 1998). This revised reclamation plan has an area three times as large as the municipality's total land area and will require about 170 million cubic meters of landfill.

The reclaimed land is to be divided up and used for a variety of puposes. The Malayan proposal envisions that close to a quarter of the area will be set aside for industrial use, while more than 30% will go to the residential and tourism sectors. Table 2 below summarizes the projected land use distribution for the proposed reclamation area.

Table 2. Recommended Land Use Distribution for the Proposed Reclamation Area

Land Use	Area (in hectares)	% of Total
Port Facilities	126.40	4.7
Industrial Use	612.90	22.6
Institutional Use	72.30	2.7
Commercial Use	142.50	5.3
Mixed Use	184.60	6.8
Gross Golf/Tourism and High-End Residential Area	488.30	18.0
Beach Area	14.40	0.4
Gross Medium-Density Residential Area	446.60	16.5
Gross Socialized Residential Area	115.60	4.3
Gross Marine Area	50.50	1.9
Landscaped Area	83.50	3.1
Major Road Network	370.20	13.7
<b>Total</b>	<b>2,707.80</b>	<b>100.0</b>

Source: Malayan Integrated Industries Corporation, 1997

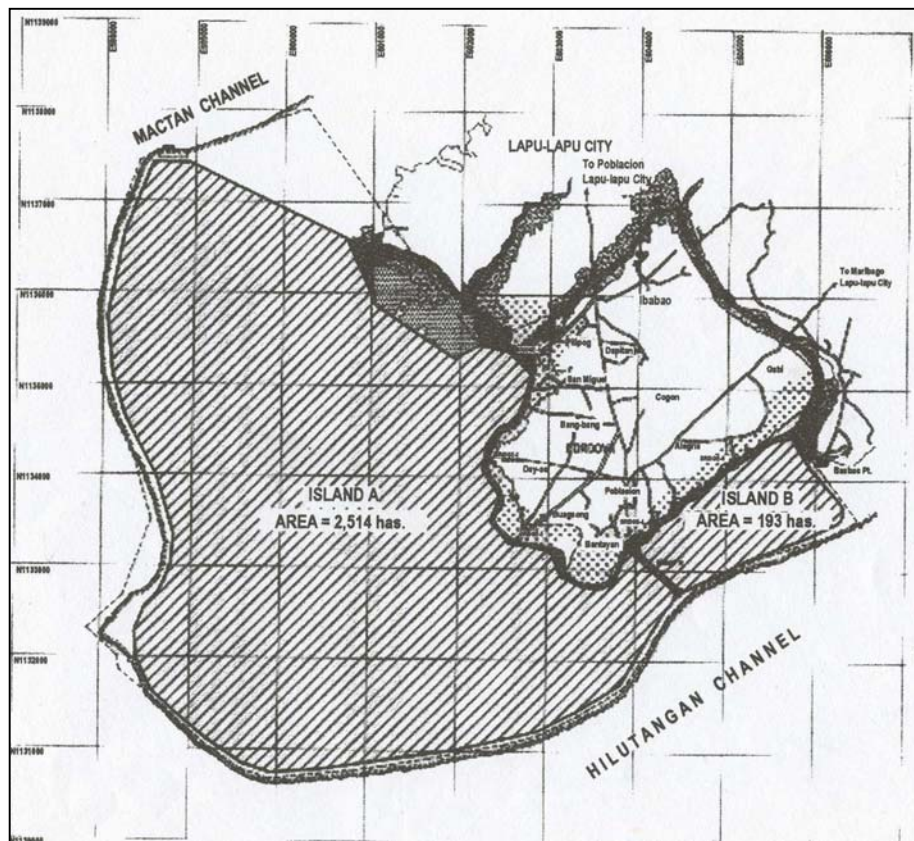
It is estimated that the reclamation project will enable Metro Cebu to absorb an additional 100-120 exporting firms. These would be expected to provide employment for about 50,000 workers. Some of these workers would come from other islands in the region, as well as from neighboring regions in the Southern Philippines (Mactan Island Integrated Master Plan 1995).<sup>5</sup> If implemented, reclamation work would be accomplished within 14 years. This would happen in three phases, at a rate of almost 200 hectares per year (Malayan Integrated Industries Corporation 1997). The MIIC reported that it expects to earn a financial internal rate of return (FIRR) of about 55% to 69%. This would come from the sale of its 70% share of the newly created land. The government (local and national) is projected to realize a cash revenue from the project of between Php 10 Billion to Php 16 Billion. This would come from the sale of its 30% share of the newly created land.

The private developer proposes to obtain landfill materials for the Cordova Project by dredging the offshore seabed around Talisay City in the southern part of Metro Cebu (see Figure 2), or by dredging other offshore areas around the neighboring island province of Bohol (Malayan Integrated Industries 1997). Despite the claims of the developers, there are many experts who are skeptical about the technological and

<sup>5</sup> The consultant's report on the Mactan Island Integrated Master Plan does not discuss in detail the assumptions used for the project's employment projections; nor does it clearly identify the expected proportion of employees that will come from within and outside the region; hence the numbers reported do not carry great weight and are likely to be overstated.

economic feasibility of this approach.<sup>6</sup> Other, already completed, projects have shown that such an approach does not work and they have had to rely on land-based quarries.

Initial proposals for the recently completed CSRP, stated that sand and sandy soil on the sea bottom offshore Talisay City was a technically and economically feasible landfill material (Katahira and Engineers Intl. 1993). Attempts were also made to procure landfill materials by dredging marine sand off the coast of the island of Leyte (refer to Appendix C for map). However this only caused months of delay since no environmental compliance certificate was issued for the necessary dredging activities. This meant that, in actual fact, diorite obtained from land-based quarrying was used as a major filling material for the Cebu South Reclamation (Montenegro 2002). This leads to the conclusion that the Cordova project will almost certainly have to use land-based quarries to supply its land-fill material.



Source: Malayan Integrated Industries Corporation, 1997

Figure 3. Proposed Reclamation Area

The Cebu Provincial Government has also come forward with its own rival reclamation proposal. This encompasses about 1,600 hectares, of which 1,100 are gazetted for export processing and light industry (University of San Carlos 1991). This has led to public bickering over the rights to undertake the reclamation project.<sup>7</sup>

<sup>6</sup> Sun\*Star Daily. "Reclamation using dredged materials impossible: Engelen." 25 November 1996, p.8.

<sup>7</sup> Sun\*Star Daily. "Tug-of-war eclipses deeper concerns." 9 June 1996, p.6.

In 1999, the Office of the President revoked the memorandum it issued granting MIIC the exclusive authority to reclaim Cordova's foreshore area. It also denied the provincial government's claim.<sup>8</sup> This does not mean, however, that there will be no reclamation work in the future. The head of Cordova's local government is very interested in undertaking a reclamation project now that the municipality's new land use and development plan has been completed.<sup>9 10</sup> In fact, the mayor, who won another term of office during the May 2004 general elections, has proposed a 200-hectare reclamation project along the coast that would encompass the two southeastern barangays, Alegria and Poblacion (Municipality of Cordova 2002). The feasibility study for this project is still being undertaken.

In light of these developments, this research primarily analyzed the social costs and benefits of the reclamation activity proposed by Malayan Integrated Industries, with some modifications that are discussed in the later part of this report.

### **2.3 Environmental Laws and Regulations Affecting Reclamation Projects**

Presidential Decree No. 1151 of 1977 (otherwise known as the 'Philippine Environmental Policy') explicitly requires all public and private entities to prepare an environmental impact statement (EIS) for every action, project or undertaking that significantly affects the quality of the environment. Presidential Decree No. 1586 of 1978 declared environmentally critical projects (ECPs) and projects within environmentally critical areas (ECAs) as projects which require the submission of an environmental impact statement (EIS). Section Four of the same decree states that "no person, partnership or corporation shall undertake or operate any ... declared ECP or project within an ECA without first securing an Environmental Compliance Certificate (ECC)."

Under the Department of Environment and Natural Resources (DENR) Administrative Order (DAO) No. 37 series of 1996 or DAO 96-37, reclamation projects equal to or exceeding 25 hectares are classified as environmentally critical projects. Proponents of such projects are required to submit an EIS for approval before the DENR Secretary or Regional Executive Director can issue an Environmental Compliance Certificate. The DAO 96-37 also provides for the establishment of an Environmental Guarantee Fund (EGF). When an ECC is issued for projects that are determined by the DENR to pose a significant risk to life, health, property, and the environment, the project's proponents must commit to the establishment of such a fund. Among the purposes of an EGF is the just compensation of parties and communities that are affected by the negative impacts of any such project. There is, however, no explicit provisions under DAO 96-37 that require the valuation of a project's potential environmental impact.

### **2.4 Stakeholders and Interest Groups**

Given the scale of the proposed CRP, there are a multitude of stakeholders and a variety of interested groups and entities. These represent many different levels of

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<sup>8</sup> Personal interview with Engr. Beth Mendoza of the Public Estates Authority Head Office – Makati City last August 25, 2003.

<sup>9</sup> Personal Interview with Cordova Mayor Arleigh Sitoy last April 17, 2003.

<sup>10</sup> Cebu Daily News. "Cordova mayor to pursue Php 6-B reclamation project." 5 February 2002, p.10.

jurisdiction<sup>11</sup> – from the local to the national. At the local level, there is the immediate Cordova community. This is made up of people who are, in varying degrees, dependent on the potentially affected coastal resource for their livelihoods. (A profile of this group is discussed in the next section.) They are, however, in a position to gain potential employment both as construction workers during the reclamation development and also as workers with firms who will locate on the newly created land. Another local stakeholder is the local government unit (LGU). It is in a position to gain increased revenues from the sale or lease of its share of any newly created land. It could also gain increased tax revenues from any new firms that locate in the area.

At a wider level, the project could provide additional employment prospects to the regional population. Many of these people may, however, also be negatively affected by the widespread quarrying for landfill materials that is expected to take place in many upland areas. Direct construction costs are expected to be born by private investors who will come from within the region or from Manila.

Seen from a national perspective, the scale of benefits from the project may be smaller than expected as it may only serve to divert economic activity from other parts of the country. However, for the purposes of this study, the analysis of social costs and benefits is limited only to those affecting populations at the local and regional levels.

## **2.5 Profile of Cordova Households**

The following were the main findings of a survey conducted between April and May, 2003 of a stratified random sample of households residing in mainland Cordova:

### **2.5.1 Demographic Composition**

More than 60% of the respondents<sup>12</sup> fall within the working age category (15 years to 65 years) while 65% are aged 30 years and below. This indicates that mainland Cordova<sup>13</sup> has a relatively young population and a large potential labor force.

### **2.5.2 Educational Attainment**

More than one-third of the adult respondents (21 years old and above) had only attended primary school, while another 34% had only reached secondary school. Some 2% of the respondents reported not having received any level of schooling at all.

If these proportions describe the mainland Cordova population, then they imply that many people may not be able to fully benefit from the increased employment prospects the restoration project may bring. This is because it is likely that the new firms locating in the project area will require their workers to have at least a high school diploma.

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<sup>11</sup> In this study, local is defined as the Municipality of Cordova. Regional refers to the Central Visayas Region which is made up of the provinces of Cebu, Bohol, Siquijor, and Negros Oriental (refer to map in Appendix B).

<sup>12</sup> Respondents here mean all members of the households included in the survey. Interviewed respondents refer to those members of the households, most often the household head, who were personally interviewed.

<sup>13</sup> Mainland Cordova does not include the island *barangay* of Gilutongan.

### **2.5.3 Income Structure**

About 62% of the household respondents had total annual incomes (from all sources) of Php 120,000 and below. This means that majority of the households (which had an average size of six) had a total income of US\$ 2,143 and below (at an exchange rate of US\$ 1 = Php 56). Furthermore, about 41% of the household respondents were classified as living below the government-defined poverty threshold of Php 217 per day or about US\$ 4 per day for an average household of six. Income distribution is also highly uneven: the bottom 20% accounted for only 4% of all income, while the top 20% accounted for 50% of all income.

### **2.5.4 Awareness and Opinions on the Proposed Reclamation Activity**

An overwhelming majority (91%) of the interviewed respondents were aware of the existing reclamation plans for Cordova. At the same time, 32% reported membership of some form of civic or people's organization.

When asked what they thought were the positive effects of coastal reclamation, about 38 % said that they saw no positive effects at all. About 46 % were of the opinion that the project would only have positive effects in terms of job creation and economic growth. About 16 % mentioned positive effects but qualified their responses by highlighting the negative effects that they felt the reclamation would have as well.

The dominant concern expressed by the survey respondents was that, while jobs might be created during the construction process, these jobs would only be temporary. There was also the worry that any new firms that might locate to the new land would only hire people with good educational records (e.g. secondary and tertiary education).

### **3.0 ESTIMATING COSTS AND BENEFITS**

This chapter describes the general approach used in this study for valuing and comparing reclamation costs and benefits.

#### **3.1 Determining the Value of the Forgone Benefits from the Affected Coastal Area**

As discussed in Section 1.3, reclamation activity leads to the loss of and damage to the coastal/marine ecosystem. The forgone benefits (in net present value terms) from the affected tideland and coral reef areas are understood to represent one of the opportunity costs of reclamation activity. While it is recognized that ecosystems can theoretically provide goods and services for a very long period of time, if they are used in a sustainable manner, the analysis in this study was limited to a definite time period of 30 years.

Panayotou (1997) has suggested that the Total Economic Value (TEV) approach is more appropriate if the change being contemplated involves the total (and irreversible) loss of the natural asset. The TEV concept encompasses not just the use values of a resource or ecosystem but their non-use values as well. Since the reclamation scenario being examined in this study involves the destruction of the entire intertidal reef area (see Fig. 5), something akin to the total economic value approach was adopted, although only use values were investigated. The monetary figures generated by this study therefore represent lower bound estimates, since non-use values were excluded. Three categories of forgone benefits were valued in this study: (1) on-site fishery; (2) reef flat gleaning; and (3) the recreational value of the affected coral area.

##### **3.1.1 On-site Fisheries and Reef Flat Gleaning**

Since the products of on-site fisheries and reef flat gleaning are mostly marketed, a price-based approach to valuation was used. For those few products that were not marketed, surrogate market prices of the closest substitutes were used. It must be noted, however, that this market-price approach to valuing the benefits from fishing and gleaning is considered a second-best measure, to be used when it is not feasible to estimate the more theoretically-correct measure of consumer and producer surplus.

The value of the loss of reef flat gleaning was taken to be the value of the total loss of the harvest (less harvest cost). This was because gleaning is a highly labor-intensive activity and can usually only be conducted on the tideland adjacent to the coast. On the other hand, the value of the loss of the on-site fishery took into consideration the potential response of fishermen to the loss of their traditional fishing grounds. Hence, this valuation was understood as being made up of two components: 1) lost fishing output; and 2) the increased cost of fishing off-site. Lost fishing output was measured as the loss in net fishing income. The increased cost of fishing off-site included the amortized capital costs of acquiring a larger motorized fishing vessel and additional fuel costs.



### **3.1.2 Recreational Value of the Coral Areas**

The valuation of the damage to Cordova's coral areas was achieved using the benefit-transfer method. This involved the transfer of unadjusted mean unit values from another valuation study. This study had measured the willingness-to-pay (WTP) of tourists and recreational divers to enter protected coral areas around Mactan Island (Arin and Kramer 2002). The adopted mean WTP was multiplied by the projected annual number of potential visitors to the coral areas that would be affected by the CRP. This gave the forgone recreational value of these coral areas.

### **3.1.3 Other Forgone Benefits from the Affected Tideland**

It is recognized that, alongside the fishery and reef flat gleaning losses mentioned above, there may be other environmental benefits that could be forgone if the CRP goes ahead and affects the area's tideland. These benefits include the pollution control and waste assimilation effects of the remaining mangrove areas, along with the carbon sink and carbon sequestration services they provide (IPCC 2001). The vast Cordova tideland may also serve as a feeding ground for migratory birds that regularly visit the nearby Olango Wetland, a site listed as internationally significant under the Ramsar Convention on Wetlands.

These possible forgone benefits were, however, not included in this study for the following reasons: (a) the valuation of pollution control may lead to double-counting as this function is linked to the productivity of on-site fisheries and may therefore be reflected in on-site fishery values; (b) carbon sink/carbon sequestration services provided by the remaining mangrove patches may not be substantial; and (c) there is no data available on the impact of reclamation on migratory birds; and obtaining such data is beyond the scope of this study.

## **3.2 Estimating the External Costs of Landfill Quarrying**

Landfill quarrying may have an adverse physical impact on the following: climate, air, noise, topography, groundwater, land use/vegetation, wildlife, surface water regime, and soil stability and erosion rates (GSECI 2002). These impacts may also be categorized as occurring on-site or off-site. However, the plurality of these physical impacts, and the lack of the biophysical data needed to model their effects, limited the ability of this study to value them.

Valuation efforts were focused on the impact of landfill quarrying on: (1) surface water regimes (e.g. changes in surface water run-off and flood/peak volumes); and (2) soil stability and soil erosion (e.g. the occurrence of landslides and mass wasting and increases in downstream sediment transport). The cost of mitigating the adverse impacts of landfill quarrying on these two environmental aspects was taken to be the value of these impacts.

Since quarrying for the proposed CRP is yet to take place, these project-specific impacts could not be directly observed. Hence, the 300-hectare Cebu South Reclamation Project (CSRP), which was the most recently completed reclamation project in Metro Cebu, was examined as a proxy. It was assumed that the two projects would use similar types of landfill material and sources, although they would require different volumes of landfill. The primary landfill material used for the CSRP was



diorite. This was sourced from small-scale quarries (defined by law as quarries of less than five hectares) in the upland areas of Cebu Province and the nearby islands of Leyte and Bohol. Due to data and resource limitations, the study of the impact of this quarrying was limited to an examination of ten of these quarry sites. All ten sites were located in Naga, a town in the southernmost portion of Metro Cebu (see Figure 1) and the place from which most of the landfill material for the CSRP was sourced.

A plan for mitigating the adverse environmental impacts of these ten quarries was drawn up. This was based on observations of their geographical positions, topography, and other physical attributes. This mitigation plan consisted of: (1) planting vetiver grass at each of the quarry sites; and (2) the construction of gabion dams (check/protection dams) to minimize downstream impacts. The cost of implementing this mitigation plan for each of the ten quarry sites was then estimated. This calculation was in turn used to estimate mitigation costs for the landfill quarrying linked to the Cordova project itself.

Given time and resource constraints, this study had to rely on an expert assessment of both the physical impacts of the quarrying, and the extent of the mitigation measures needed, at each of the ten sites. Admittedly such a second-best approach to measuring damage from landfill quarrying also leaves out temporary and localized effects on nearby households. The monetary figures generated are therefore likely to be underestimates.

It is recognized that this approach is not an ideal method for estimating the physical impacts of landfill quarrying and the corresponding mitigation costs. Another, potentially better, approach would have been to look at the impact of the quarrying on variables such as rates of erosion, sedimentation/siltation, mass wasting, surface water run-off and flood peak volumes. However, it was not possible to pursue this course of research due to the absence of relevant models and, more importantly, the absence of data on the above-mentioned variables.

### **3.3 Obtaining Estimates of Economic Benefits and Construction Costs**

While the private sector proponent of the CRP undertook a financial feasibility study (Malayan Integrated Industries Corp. 1997), no economic cost-benefit analysis was undertaken. Therefore, although there was a financial evaluation of the project, derived from cash flows coming from the projected sales of reclaimed land, no further estimates for projected economic benefits were available.

Originally, this study intended to adopt the economic benefits estimated for the CSRP. These were reported in the 1994 CSRP Implementation Program, a report prepared by Katahira and Engineers Intl. in 1994 and submitted to the CSRP Project Management Office. In this report, the general assumption was that benefits stem from activities on the newly created land. Three kinds of economic benefit associated with coastal reclamation were discussed, namely: (1) additional employment value gained from activities on the newly created land (the incremental number of jobs created multiplied by the real wage rate); (2) additional growth in the Gross Regional Domestic Product (GRDP) generated by activities on the newly created land (or value of additional production); and (3) travel-time savings from the creation of new road networks.

The CSRP report's findings were not used, however, because of a number of problems associated with the research. The report did not clearly discuss the assumptions used or how benefit values were derived. It was also felt that adding additional employment (defined as the incremental number of jobs created multiplied by the wage rate) to additional growth in the GRDP constituted double-counting, since the value of labor income was already part of GRDP. Furthermore, travel-time savings were not considered to be very relevant to the CRP, since it is located in an area where traffic congestion is not yet a significant issue. In contrast, the CSRP provides an alternative route to the currently over-burdened South Expressway.

Despite the fact that the GRDP research was not a 'good fit' for the CRP study, the general idea it was based on was relevant. That is, economic benefits from reclamation stem from the kinds of activities undertaken on the newly created land. In this study, these benefits were measured as estimated rents or profits from such activities. The construction/operation/maintenance costs (simply referred to in this report as direct costs) that were used to complete the cost-benefit analysis of the CRP were based on the annual engineering cost estimates (for a 14-year period) reported in the MIIC feasibility study.

### 3.4 Comparing Costs and Benefit Streams

A cost-benefit analysis of the CRP was undertaken. It was based on the reclamation proposal/project description of Malayan Integrated Industries Corp. It was limited to an examination of the costs and benefits occurring at the local and regional levels. The following were excluded from the analysis: the external costs associated with the additional noise and air pollution caused by construction work; and the externalities of additional human activity on the new land.

Reclamation costs and benefits were discounted and summed over a period of 30 years<sup>14</sup>; after which the net present value (NPV) was computed. Sensitivity analyses were undertaken with respect to following: (a) variations in important parameters such as the discount rate (specifically 8%, 10%, and 12%); (b) assumptions concerning the start of benefit flows; (c) the volume of landfill required; and (d) assumptions concerning the potential number of recreational visits to the affected coral area.

To summarize, the cost-benefit rule took the form of:

$$\sum_i (B_i - C_i) (1 + r)^{-t} > 0$$

Where:  $B_i$  = rents from additional production located on the reclaimed land;  $C_i$  = direct construction costs, forgone benefits from loss of the coastal resource, and external costs from landfill quarrying and;  $(1 + r)^{-t}$  = discount factor ( $r$  is the discount rate used).

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<sup>14</sup> It is felt that a time period of 30 years is sufficient for the purposes of this study although one must keep in mind that well-built reclamation areas can last for centuries and ecosystems can provide services for even longer periods of time if used in a sustainable way.

## 4.0 ENVIRONMENTAL COSTS OF THE CORDOVA RECLAMATION PROJECT

### 4.1 Forgone Benefits from Affected Coastal Resources

As previously mentioned, three categories of forgone benefits from coastal resources were valued in this study: (1) on-site fishery, (2) reef flat gleaning, and (3) the recreational value of the affected coral area.

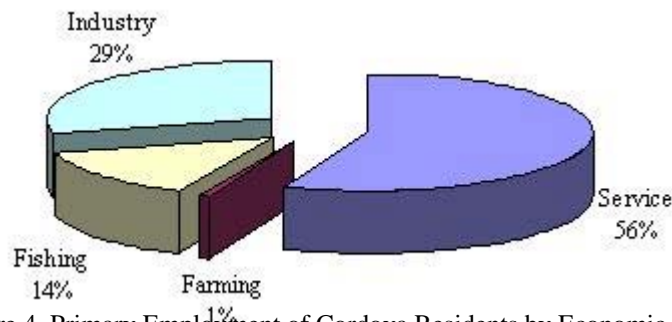


Figure 4. Primary Employment of Cordova Residents by Economic Sector

#### 4.1.1 On-site Fishery

A survey of a representative sample of Cordova households (excluding the island of Gilutongan) was conducted to generate data on the volume and cost of the fish and shellfish/mollusk harvested from the affected intertidal reef area.<sup>15</sup> Stratified systematic sampling of the households was used. Stratification was done by barangay. The sample size per strata was proportional to the size of the household population of that strata or barangay. A total of 377 out of 6,449 Cordova households<sup>16</sup> were interviewed using a 17-page structured survey. This was pre-tested at two non-sampled but similar sites. Each personal interview was conducted by a two-person team and completed surveys were field and office edited prior to encoding. The following findings were made:

##### *Extent of Fishing Activities*

Of the 62% of respondents (interviewees and their household members) who reported being employed at the time of the interview, 14% reported being primarily employed in fishing and fishing-related work such as fish vending. Another 19% reported being engaged in fishing and fishing-related work as their secondary or supplementary employment. All in all, this means that about 33 % of employed respondents were engaged in fishing as either their primary or secondary employment. This meant that, for the mainland Cordova population as a whole, approximately 1,300 individuals in the town (excluding the island of Gilutongan) gained part of their livelihood from fishing.

<sup>15</sup> This was done because no data for on-site mollusk harvests (from reef flat gleaning) and on-site fish/shellfish harvests were available from relevant government offices/agencies such as the Cordova Municipal Agricultural Office or the Bureau of Fisheries and Aquatic Resources (BFAR).

<sup>16</sup> This means that 1,979 individuals out of a population of about 34,000 were included in the survey.

It was also found that almost a quarter of all households interviewed had at least one household member engaged in fishing. Three barangays on the southeastern coast (Catarman, Poblacion and Alegria) were among the most heavily dependent in terms of the number of households that had members engaged in fishing. It is therefore of note that the local government is planning to begin a reclamation area of about 200 hectares along the coast of Poblacion and Alegria (the coast facing the Gilutongan channel, refer to Figure 3).

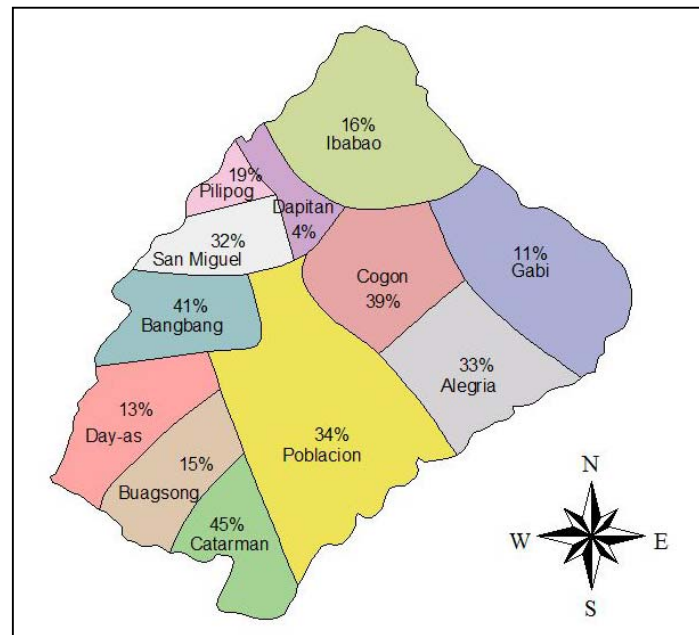


Figure 5. Households per Barangay with at Least One Member Engaged in Fishing

### ***Location and Description of Fishing Activities***

Around 83% of fishing respondents spent three-fourths of their fishing time within or adjacent to the intertidal flat. This confirms that the affected tidal flat is the primary fishing ground of Cordova fishermen. Pre-test interviews at Tangke, a barangay fronting the Cordova flat across the Mactan-Cebu Channel (please refer to Figure 1) also showed that the flat is an important, although not a primary, fishing ground for fishermen from as far as the southern part of Metro Cebu on Cebu Island. This means that the estimate of the value of the on-site fishery is a lower-bound figure since the value of the fish catch by fishermen from areas outside of Cordova was not counted.

Almost all of fishing activities in the affected area are small-scale family affairs that can be categorized as artisanal. The majority (97%) of fishing respondents were either not using fishing vessels (25%) or were using fishing vessels that were below three gross tons in capacity (72%). Slightly more than 50% of the fishing vessels were non-motorized. This indicates that the majority of fishermen did not have the immediate capacity to venture to more distant and more abundant fishing grounds such as those found near the waters of Bohol Island (see Appendix F for map). At 2003 prices, it would cost approximately Php 36,000 (US\$ 643) for a fisherman to purchase a

motorized fishing vessel that would be adequate for the journey to fishing grounds in nearby provinces like Bohol. Incremental annual fuel costs for such a fishing journey would amount to about Php 19,000 (US\$ 340).<sup>17</sup>

Respondents reported that they caught a total of 51 different types of fish, crabs, squids, octopuses and eels from the intertidal flat. The four most commonly caught kinds of marine products were fishes from the families Siganidae (spinefoot/rabbitfishes), Callionymidae (dragonets/mandarinfish), and Labridae (wrasse) as well as common varieties of crabs. Prices for spinefoot/rabbitfishes in three Metro Cebu wet markets ranged from Php 70-100 per kilo. On the other hand, dragonets/mandarin sold for an average of Php 35 per kilo., crabs and wrasse sold for an average of Php 40 per kilo.

### ***Income from On-Site Fishing***

The average annual revenue from fish catches from the Cordova flat for each fisherman ranged from Php 33,896 to Php 46,608 (based on 2002 prices). This translates to an aggregate annual fish revenue of about Php 44 million to Php 61 million. When multiplied by the number of fishermen working in the area (1,300 – see the second paragraph of this section), this gives an annual income figure for the area's fishery of between US\$ 786,000 and US\$ 1.1 million. As mentioned previously, this represents a conservative estimate.

The aggregate net fishing income<sup>18</sup> from the Cordova flat was estimated to range from Php 17.2 million to Php 29.9 million. This figure is net of all fishing-related costs at constant 1997 prices including an imputed shadow wage rate of about Php 9 per hour (which is 35% of the legislated minimum for areas outside Metro Manila). Furthermore, it was found that Cordova fishermen spent an average of eight hours a day fishing. This translates into a shadow wage rate of about Php 73, an amount that is in the same range as that paid to workers in the area whose educational attainment is high school and below.

### ***Net Present Value of Forgone Benefits from On-Site Fishery***

To determine the benefits from on-site fishing that will be forgone if the CRP goes ahead, it was necessary to first set-up a 'without the project' scenario. For this study, it was assumed that if the reclamation project does not go ahead, then the Municipality of Cordova will continue to implement its current Coastal Resource Management Plan (CRM). This plan serves a dual purpose. Firstly, it lays the basis for estimating the size of future harvests. Secondly, it highlights the alternative policy directions available to the local government. It is reasonable to assume that this plan will be continued given that the municipality has already begun its CRM planning process and has already achieved Level 1 certification (in a three-level CRM certification system).<sup>19</sup>

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<sup>17</sup> Unless otherwise stated, all peso-dollar conversions in this report are based on an exchange rate of US\$ 1 = Php 56

<sup>18</sup> This is net of all fishing-related costs at constant 1997 prices and an imputed shadow wage rate w/c is 35% of the legislated minimum for areas outside Metro Manila. This shadow wage rate was based on existing daily wages for workers in the area whose educational attainment is high school and below.

<sup>19</sup> Based on an interview conducted last May 6, 2002 with Leonides Alcoy, Cordova Municipal Planning and Development Officer.

A review of data on fish trap yields in Sumilon Island, another site in Cebu province where a form of coastal resource management has been implemented since 1977, suggested that a 5% annual increase in fishery production (and gleaning harvest) was a realistic assumption to make for the area. In an article by Russ and Alcala (1994) on the experience of coastal resource management efforts in Sumilon Island, positive changes in the yield of reef fish from traps throughout the period 1976-1986 were reported to range from 6.25% to 38.30%. The authors attributed the increases in yield to biomass spillover from the marine reserve established in the area. A 5% annual increase in fish production over a 30-year period is plausible given that improvements begin from a very low production baseline in what was formerly a highly-productive coastal area.

Taking this into account, a 5% annual increase in on-site fishery production for the 30-year period was assumed in the 'without the project' scenario. Half of the net income from this on-site fishing was assumed as forgone or lost in the 'with project' scenario. As previously discussed, the other forgone benefits from on-site fishing caused by the CRP were assumed to be in the form of incremental fishing costs (for fishermen who shift to more distant sites). These were measured as the amortized capital costs of acquiring a motorized fishing vessel and the additional fuel expenses for longer fishing journeys. Using these assumptions, the net present value of the on-site fishery was estimated, at an 8% discount rate, as approximately Php 290 million or US\$ 5 million for a 30-year period.

#### **4.1.2 Reef Flat Gleaning**

Reef flat gleaning refers to an activity that is relatively distinct from fishing and which generally involves collecting (normally by hand) marine products such as shellfish, mollusks, sea cucumbers, sea urchins, and others.

##### ***Extent of Reef Flat Gleaning Activities***

Most of the reef flat gleaning activities undertaken by Cordova residents are to produce food for family consumption or to help provide supplementary income. None of the respondents reported that reef flat gleaning was their primary employment activity, although 34% reported gleaning as their secondary type of employment. Of this 34%, a majority (90%) concentrated their gleaning efforts on the Cordova intertidal flat. It was estimated that there were about 1,500 to 1,800 people engaged in some form of gleaning. The majority of the gleaners were women. The southeastern barangays of Gabi, Alegria, Poblacion and Catarman had the highest number of households in which at least one member was engaged in some form of gleaning activity.

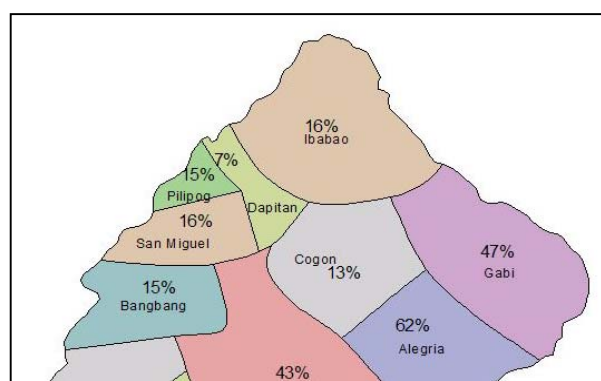


Figure 6. Households per Barangay with at Least One Member Engaged in Gleaning

#### ***Net Present Value of Gleaned Marine Products***

Each gleaner harvested approximately 460 kilograms of marine products each year. At an average price of Php 20 per kilo or US\$ 0.36 per kilo, this amount is worth about Php 9,180 annually or US\$ 164 annually. This roughly translates into an aggregate value of Php 8.9 million to Php 10.9 million annually (net of imputed labor costs) or US\$160,000 to US\$ 195,000.

The same 'without project' scenario used for estimating forgone benefits from on-site fishing was used for reef gleaning. The net present value of gleaned marine products, for a 30-year period at an 8% discount rate, was estimated to be approximately Php 207 million or US\$ 3 million.

#### **4.1.3 Recreational Value of Coral Areas**

The coral reefs around Mactan Island (refer to Figure 2 for map), are considered relatively unique on a global scale because they lie within a major urban area that is home to almost two million people. The reefs are said to have significant economic potential (Ross et al. 2003). The forgone recreational value of the coral area is therefore an important component of the environmental costs of reclamation.

#### ***Description of the Affected Coral Area***

The valuation of the potential damage that the reclamation work would have on corals was accomplished using unadjusted unit-value benefit transfer. Due to the lack of updated biophysical data on the condition and extent of the affected coral area, an underwater assessment was first undertaken to establish its physical characteristics. Twelve sampling stations were established within the Cordova tidal reef flat and marked using a global positioning system (GPS). The line transect intercept and the fish visual census methods were employed.

The results of the underwater assessment revealed that the coral reefs of Cordova are typical fringing reefs which are generally in fair condition with high biological diversity. Live coral cover ranged from 11.74% to 69.60%. The genera *Pocillopora* was the most common in the area. This was followed by the genus *Fungia* and *Seriatopora*. Most of the coral life forms were of the encrusting, branching and massive types (see Plate 3 for a sample photo). Good coral populations were located only in the southern reef edge. The coral reefs were poorly developed in the

southwestern part of the study area, which faces Cebu Harbor across a narrow channel (please see Plate 1 for a photo of the southwestern coast). This poor coral cover was attributed to the area's high levels of suspended particles in the water column (USC 1998) and to pollution from industries, domestic effluent and oil discharges from Cebu City.

The overall estimate of the coral reef area was 9.35 km<sup>2</sup> or 935 hectares. Of this area, an estimated 640-hectare coral area in the south and southeastern portion of the reef flat was classified as having fair to good cover that could potentially be developed for recreational diving and snorkeling. It is of note that the total coral reef area is larger than the land area of the town of Cordova.

Table 3. Average Percentage of Live Coral Cover and Associated Substrate

Substrate/Year	Cordova Main Island (2003)	Gilutongan Marine Sanctuary (1998-2001) <sup>20</sup>
Algae	3.54	3.50
Live Corals	40.41	33.63
Others	8.85	3.38
Abiotic	52.39	57.63

The condition of coral reefs can be categorized according to their live coral cover: (a) 75 % and above is classified as 'excellent condition'; (b) 50 % to 74.9 % is considered good; (c) 25 % to 49.9 % is fair; and (d) below 24.9 % is poor. A comparison of the coral reef fringing the Cordova mainland with the coral area within the Gilutongan Marine Sanctuary shows that both can be classified as fair and are relatively similar in terms of live coral cover.

### ***Current Benefits of Coral Reef Protection to the Municipality of Cordova***

Mactan Island (refer to Figure 2) is a popular high-end tourist and dive destination in the Philippines. The length of the eastern coast of Mactan Island (including Cordova) is the site of various medium to high-price resorts that cater to both domestic and foreign tourists. Located nearby, across the Gilutongan Channel are several smaller islands that are only 15 to 30-minutes away from Mactan Island by motorized small boats. This group of islands is a popular destination for 'island hopping' domestic and foreign tourists. The larger island of Olango is a critical stop-over for birds traveling the East Asian Migratory Flyway (White et al. 2000) and its southern coast is listed as a Wetland of International Significance under the Ramsar Convention. This group of islands administratively falls within the jurisdiction of

<sup>20</sup> Source: Arceo, H.O., A. J. Uychiaco, J. Apurado, T. Menguito, R. Blanco, P.A. Gaite, R. Amolo, J. Gatus, A. Diola, S. Bagalihog, M.F. Portigo, D. Valles, A. Garcia. 2003. Gilutongan Marine Sanctuary, Cordova, Cebu: Philippine Coral Reefs Through Time. Workshop proceedings. Second of the Atlas of Philippine Coral Reefs Series. P.M. Aliño (ed.). *Coral Reef Information Network of the Philippines (PhilReefs)*, University of the Philippines Marine Science Institute, Quezon City, Philippines and the Marine Parks Center, Tokyo, Japan, 66-68.



Lapulapu City; except for Gilutongan Island which is a barangay within the administrative jurisdiction of Cordova.

Currently, the municipality manages a 14-hectare marine sanctuary (0.15 km<sup>2</sup>) located off the western portion of Gilutongan (facing Mactan Island). The area was declared a ‘fish sanctuary’ in 1991, but it was only recently that detailed management measures were introduced and regulations strictly enforced. Since 2000, the municipality has been collecting accreditation fees from dive operators and user fees from visitors. Around 30% of the revenues from fees go to the barangay while 70 % go to the municipality which assumes most of the operation and management costs.

The sanctuary is now a very popular dive and snorkeling destination with approximately 3,367 visitors per hectare per year. This translates into more than 100 visitors per day or 9-11 visitors per hectare per day. Annual revenues are now close to Php 2 million and contribute to a very substantial portion of the local government budget. It was observed, based on personal experience, that this number of visitors is already close to the sanctuary’s full capacity and that the area is in danger of becoming congested.

Table 4. Number of Visitors to Gilutongan Sanctuary

Type of Visitor	2000	2001	2002	2003
Scuba diver	3,043	10,095	23,574	25,929
Non-scuba diver	2,490	8,260	19,287	21,214
<b>Total</b>	<b>5,533</b>	<b>18,355</b>	<b>42,861</b>	<b>47,143</b>

Source: Municipality of Cordova

### *Existing WTP Estimates to Enter Protected Coral Areas*

The WTP values used in this analysis were obtained from a study conducted in 1997 by Tijen Arin for the Coastal Resource Management Project in the Philippines. Arin conducted an exploratory contingent valuation study at three major dive destinations in the Philippines, namely: Anilao, Batangas; Panglao Island, Bohol; and Mactan Island, Cebu. A non-probability sample of 129 dive tourists was selected. They were interviewed to elicit their willingness-to-pay to enter protected coral reefs at the above mentioned sites. There were 37 respondents in Anilao, and 46 each on Mactan Island and Panglao Island.

The ‘payment card’ format was used to elicit information on the tourists’ WTP. A range of US\$ 0 to US\$ 10, together with an open-ended choice, was presented to the respondents (Arin and Kramer 2002). The authors did an econometric analysis relating the WTP amount to explanatory variables such as gender, age and college education and reported the resulting coefficients and t-statistics. Coefficients for income were not



Plate 3. View of Coral Cover at the Southern Reef Area



Plate 4. Reef Fishes at the Southeastern Reef Area

reported since this was not included as an explanatory variable due to the unreliable nature of the income data available for Anilao, Batangas. Since no specific marine sanctuary was mentioned in the interview question, the WTP results can be applied to all protected coral areas within the general vicinity of Mactan Island, including the Gilutongan Marine Sanctuary. Table 5 summarizes the reported characteristics of the Mactan sample and the WTP results.

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Table 5. Characteristics and WTP Results from Mactan Sample: Arin & Kramer (2002)

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Summary of findings

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Number of respondents	46
Philippine residents	10.9 %
Average length of stay at location	4.8 (4.6)
Average number of dive days	3.1 (6)
Average monthly income (US\$)	4,663 (5,235)
Average WTP (US\$)	5.5 (6.8)

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*Note: Standard deviation in parenthesis*

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Source: Arin and Kramer (2002)

### ***Net Present Value of Forgone Recreational Benefits from the Coral Reef***

To estimate the value of forgone recreational benefits from the 640-hectare coral reef area that will be affected by the reclamation work, assumptions were made concerning the potential number of annual visitors. Based on an examination of the past experience of Gilutongan Island, projections of annual visitor density made for the 30-year period were analyzed. These projections were then multiplied by the mean WTP estimate for coral areas in Mactan Island reported by Arin and Kramer (2002). This approach assumes that the characteristics of visitors to the Cordova reefs are similar to those in Arin and Kramer's study (2002). If, as suggested by the Gilutongan experience, full capacity for a coral reef area is in the range of 3,500 to 4,000 visitors per hectare per year, then a 640-hectare coral reef at full capacity can accommodate almost 2.2 to 2.5 million visitors annually. Based on the projected number of visitors within a 30-year period shown in Figure 7, the net present value of forgone recreational benefits from the affected coral area was estimated at approximately Php 1.7 billion or US\$ 31.6 million.

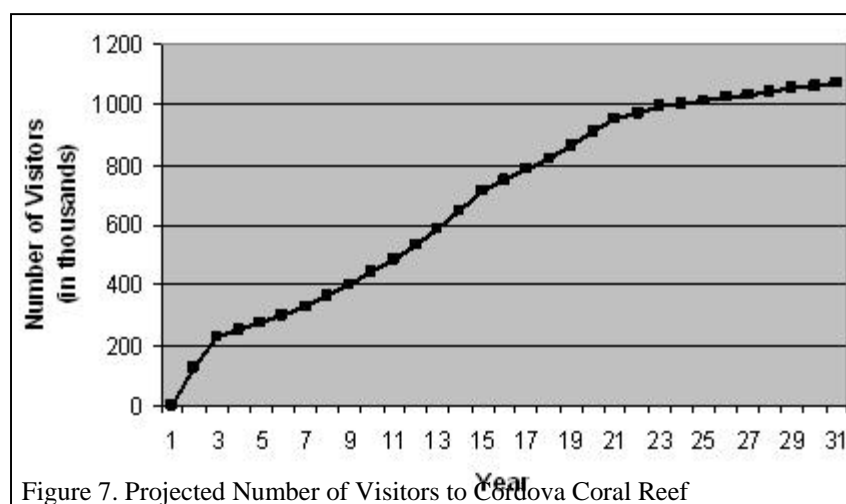


Figure 7. Projected Number of Visitors to Cordova Coral Reef

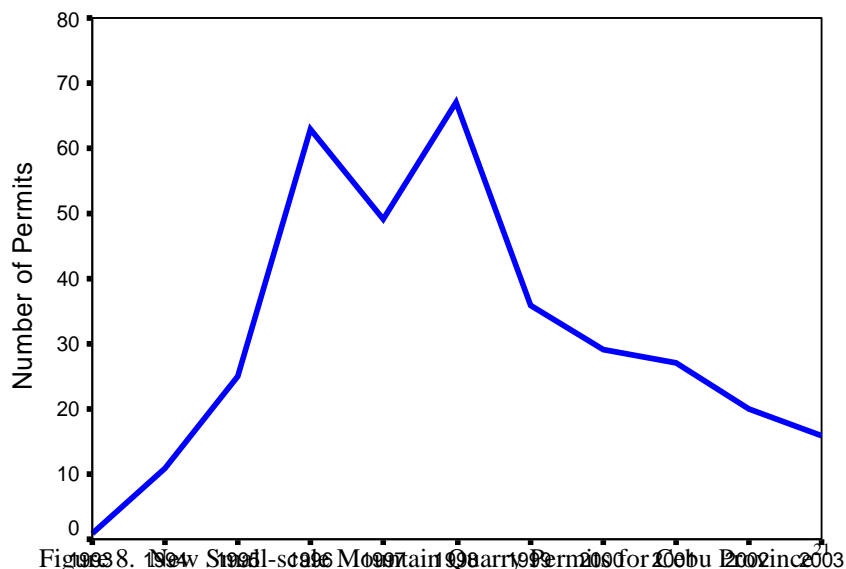
### *Assumptions in Estimating Flow of Forgone Recreational Value from Corals*

In calculating the cost of coral damage (which is understood as the forgone value of potential recreational uses), it was assumed that without the reclamation project, the town of Cordova would pursue ways to protect, manage and improve the relatively healthy coral areas on its southern reef edge. It was also assumed that this conservation work would be done in a similar way to that currently carried out at the Gilutongan Marine Sanctuary.

It was assumed that the coral area would attract, over a 30-year period, an average of 1,000 visitors per hectare per year. An examination of the data on the number of visitors per hectare to the nearby Gilutongan Sanctuary suggested that this was a reasonable assumption. According to the Municipality of Cordova, for the years 2002 and 2003, there were more than 3,000 visitors per hectare. Furthermore, it was assumed that the first year of the 30-year period used in this analysis would be spent setting up a coral management program. It was therefore assumed that there would be no income from visitors during this initial period.

## **4.2 Damage from Landfill Quarrying**

As discussed above, the impact of reclamation extends beyond its obvious and immediate impact on coastal resources. Landfill quarrying is another important channel through which reclamation affects the environment. In previous reclamation projects in Metro Cebu, landfill material was sourced from small-scale quarries in upland areas and this led to a large increase in small-scale quarrying activities. Figure 13 shows the number of new small-scale mountain quarry permits issued by the Cebu Provincial Environmental and Natural Resources Office (PENRO) each year within a 10-year period. The peak in the number of new permits issued coincides with the implementation of the CSRP.



<sup>21</sup> Source: PENRO, DENR-EMB



Small-scale quarry permits may be issued for two types of distinct quarry activities: sand and gravel quarrying and mountain quarrying. Limestone and diorite are among the materials most commonly extracted from small-scale mountain quarries and both are used, especially diorite, as reclamation landfill or construction material.



Plate 5. Diorite from a Small-scale Quarry

The Local Government Code of 1991 devolved the power to issue all types of quarry permits to local and provincial government units, but in 1999 the authority to issue permits for quarry operations of more than five hectares was returned to the DENR through Republic Act 7942, otherwise known as the Mining Act of 1995. The provincial government is still responsible for issuing permits for quarry operations of five hectares and less. PENRO is currently in charge of processing quarry permits (e.g. application and monitoring) and it recommends approval to the provincial governor. Among the requirements for obtaining a small-scale quarry permit is an Environmental Compliance Certificate (ECC) from the DENR.<sup>22</sup>

#### **4.2.1 Impacts of Landfill Quarrying**

Landfill quarrying may have a multitude of environmental impacts which include a few or all of the following:

##### ***Temporary Increases in Noise and Dust Pollution***

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<sup>22</sup> Personal Interview of Mr. Glen Baricuatro, PENRO head. October 2003.

Quarrying operations in close proximity to residences can generate noise pollution that can reach as high as the hazard threshold of 95 decibels (GSECI 2002). This noise pollution usually comes from heavy-machine operations. Dust emissions coming from the mining operations may also be a problem to residents.

### ***Changes in Surface and Groundwater Regimes***

The clearing of vegetation for quarry operations may also affect groundwater recharge and runoff. The infiltration rate for groundwater recharge on cleared land has been found to decrease by as much as 30 % (Morgan 1995). This 30 % loss may be translated into runoff water. Increases in runoff generally start when the topsoil is already eroded (completely removed in the case of landfill quarrying) or when the soil is highly compacted. The accumulated runoff coming from the quarry area may drain into a river outlet, leading to an increase in surface water volume and velocity, thus, potentially endangering people living downstream. Also, mining and quarrying in a limestone area poses the threat of groundwater pollution (since limestone is a porous geologic formation with a high transmissivity).

### ***Increased Soil Erosion and Downstream Sedimentation/siltation***

There is usually a high risk of soil erosion in areas where land use has been changed and this is especially true when vegetated land is cleared. This can also exacerbate soil erosion caused by seasonal weather changes. For instance, the degradation of land reduces the amount of vegetation that grows on it during the Summer period from April to May. When the rainy season (especially one of high rainfall intensity) ensues, usually from June to November, soil erosion is therefore higher than it would have been, since the vegetation has not grown sufficiently to protect the soil (Morgan 1995; Poels and van Mensvoort 1998).

Soil erosion is triggered by many factors. It results from the combined effects of rainfall erosivity, soil erodibility, slope steepness, slope length, ground surface cover, and conservation practices (Spaan and Meindertsma 2001). If land is bare and exposed, its rainfall erosivity increases since it is not protected from rain impact. This leads to increased erosion. This is a crucial factor in countries like the Philippines which experience high rainfall intensities during the rainy season from June to November. Soil erodibility describes the resistance of the soil to erosion. Soil erodibility varies with the different properties of the soil: texture, aggregate stability, shear strength, infiltration capacity, and organic and chemical content. Soils with high erodibility are prone to erosion. Areas with greater slope length and slope steepness are also vulnerable to increased soil erosion rates. Quarry operations located in such areas may contribute to more erosion than they would do if they were located in less vulnerable areas.

Gonzaga (2002) measured soil loss (using the ACED method) on a plot of land in Cebu's Mananga watershed in September 2001. The plot had a 36 % slope and sandy clay loam soil with less than 10% vegetation. The registered soil loss reached about 49 tons per hectare (t/ha). Kemeling (2000) also measured soil loss (using Gerlach throughs) in Cebu's Kotkot watershed (bare soil with a 35% slope) in September 1999 and registered about 81 t/ha. The erosion values are indicative of what may occur on quarried areas during high-rainfall months. Eroded material may be transported downstream through waterways and rivers. It can then block roads and drainage canals, and damage other downstream structures.

### ***Increased Occurrences of Landslides***

Landslides (mass wasting) occur when the shear stress exceeds the shear strength of the materials forming the slope (Spaan and Meindertsma 2001) and are an extreme form of soil erosion. They usually occur on deep soils that have poor soil condition and are aggravated by: (a) prolonged rainfall that causes the soil to be saturated; and (b) a lack of vegetation cover to hold the soil together. Quarrying also increases the risk of landslides due to slope failures because it changes the topography and slope steepness of an area.

#### **4.2.2 Landfill Quarrying in the Municipality of Naga, Cebu**

In order to have a basis for estimating the environmental costs of landfill quarrying, the case of ten quarry sites located in Naga, Cebu was examined.

##### ***Profile of the Municipality of Naga, Cebu***<sup>23</sup>

Naga is a town located in the southern part of Metro Cebu (see Figure 1). It has a total land area of 9,258 hectares and is subdivided into 28 barangays. In 2000, it had a registered population of 80,189. It had almost 16,000 households and a population density of 8.6 persons per hectare. Much of the region's land area is devoted to rain-fed agriculture where crops such as rice, corn, root crops, legumes, vegetables, and tobacco are commonly grown. Fishing is also a major livelihood of the people living in coastal barangays. At the same time, a large coal-fired power generation plant and a number of large mining and extractive industries are also located in Naga. Prominent businesses include the Philippines' largest cement manufacturers. Seventy-four percent of Naga's land area is classified as having a slope of more than 18 %. Almost half of the land area is categorized as being severely susceptible to erosion. The town's soils are predominantly clay. There is also some clay loam with a soil type known as Faraon clay covering half the land area. Materials such as limestone, cement raw materials, marble, and coal are abundant. As is the case in Cordova, the local government unit also envisions reclaiming 200 hectares of its coastal area (Municipality of Naga 2006).

##### ***Profile of Ten Landfill Quarry Sites in Naga, Cebu***

During the period 1994 to 2002, there were 33 Environmental Compliance Certificates (ECC) issued for about the same number of small-scale mountain quarries operating in Naga, Cebu. These make up 30 % of the total number of ECCs issued for small-scale quarries in the provinces of Cebu and Bohol during the said period. Out of 28 barangays, nine had small-scale mountain quarries. For this study, ten quarry sites located in six barangays were examined. All ten quarry sites were three hectares or less in size. All ten sites supplied landfill materials to the Cebu South Reclamation Project (CSRP). All produced diorite except for the site in Barangay Inayagan which produced limestone. The quarry sites in Barangays Inayagan, Mainit, and Pangdan were active while the seven other sites in Barangays Cantao-an, Uling and Lutac had ceased operation after the completion of the CSRP.

The majority of the sites listed in Table 6 operated during the years 1998-2000. Site 8 was the earliest operating site and was active in 1996 while site 6 in Barangay Mainit only began operations in 2003. Quarrying operations at the sites were often very

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<sup>23</sup> Source: Naga Comprehensive Land Use Plan (1996-2005)

intensive (more than eight hours a day every day of the week when the weather permitted) to meet the deadline for the completion of CSRP. They lasted for as short a period as one month to as long a period as one year. During the peak of CSRP construction, quarrying operations often lasted beyond 9 p.m. The typical traffic from the sites was 70-150 ten-wheeler trucks per site per day. These ten-wheeler trucks were capable of carrying a maximum load of 15 cubic meters of landfill. This translates to an average production of 150,000 cubic meters of landfill for each of the ten sites. Sites 1, 6 and 10 were active during the time of the survey (December 2003 to February 2004) and continued to supply materials for the Cebu South Coastal Road that was being constructed on the CSRP. The ten quarry sites investigated in this study produced an estimated 1.5 million cubic meters of landfill materials during their varied periods of operation within the years 1996 to 2003. This is about 10 % to 12 % of the total volume of landfill used for the CSRP.

Six of the ten sites are located near the Pangdan River which is the major river system in Naga, Cebu and are easily accessible from the Naga-Uling Highway, a major road network connecting the west coast towns of Cebu Island to Metro Cebu. The predominant land uses adjacent to the ten sites were agricultural and residential. Sites 1, 4, and 9 were located adjacent to public elementary schools. A total of 321 households lived within a 200-meter radius of the sites. Before quarry operations, land use at all ten sites was predominantly agricultural. As is typical of upland agricultural systems in Cebu province, each site was formerly planted with a diverse assortment of root crops, vegetables, corn, banana, coconut, fruit trees (e.g. mango, jackfruit, star apple, guyabano etc.) and woody vegetation (e.g. ipil-ipil and madre de cacao trees) that was used as fuelwood. Site 6 had been in a fallow condition for a long time prior to quarrying.

Table 6. Summary Profile of Ten Quarry Sites in Naga, Cebu

Site Number/ Location	Estimated landfill produced <sup>24</sup> (in m <sup>3</sup> )	Period of operation	Former land use	Presence of road or river system nearby
1. Pangdan	600,000 m <sup>3</sup>	2000 (8-9 mos.); May-Dec. 2003	Agricultural; Fuelwood source	Naga-Uling Highway Pangdan River
2. Cantao-an	380000 m <sup>3</sup>	1999-2000	Agricultural	Municipal Road
3. Cantao-an	250,000 m <sup>3</sup>	1999-2000	Agricultural	None of both
4. Cantao-an	400,000 m <sup>3</sup>	1999-2000	Agricultural	None of both
5. Uling	15,000 m <sup>3</sup>	July-Aug. 2001	Agricultural	Creek on both sides

<sup>24</sup> Estimates were based on interviews of quarry site operators, landowners and data from PENRO. These are expected to be underestimates of actual production.



6. Mainit	6,000 m <sup>3</sup>	July 2003; Jan. 2004	Fallowed agricultural land; Fuelwood source	Naga-Uling Highway Pangdan River
7. Lutac	221,625 m <sup>3</sup>	Dec. 1998- Dec.1999	Agricultural	Naga-Uling Highway; Pangdan River
8. Lutac	259,200 m <sup>3</sup>	June 1996- Nov.1997; Sept.1999- Sept.2000	Agricultural	Naga-Uling Highway; Pangdan River
9. Lutac	270,000 m <sup>3</sup>	1999-2000 (10 months only)	Agricultural	Naga Uling Highway; Pangdan River
10. Inayagan	302,400 m <sup>3</sup>	Mar. – Sept. 2001	Agricultural	Inayagan River
<b>TOTAL</b>	<b>1.5 million m<sup>3</sup></b>	--	--	--

### *Profile and Perceptions of Households around Quarry Sites*

Since most reclamation projects require landfill quarrying, they impact, not only coastal communities, but also on people in upland areas as well. In order to draw a picture of who these people are and how they perceive the impacts of reclamation activities, households near the ten quarry sites (approximately within a 200-meter radius) were identified, listed and interviewed.



Plate 6. Site 1: Active Quarry in Pangdan, Naga (January, 2004)





Plate 7. Site 6: Diorite Quarry near Pangdan River at Mainit, Naga



Plate 8. Site 10: Limestone Quarry at Inayagan, Naga

Households at all ten sites earn an average income of Php 103,000 annually or about US\$ 1,800. The majority of the lower income households were concentrated around sites 2, 5, 8, and 10 where more than half of all reported annual incomes were below US\$ 1,000. Around 43 % of household respondents felt they were negatively affected by quarrying activities. The most common complaints centered around four issues: noise, dust, rock/landslides, and increased hazards on roads from large quarry trucks in a hurry to meet supply deadlines. At the peak of quarrying operations in 1999-2000, households complained about severe noise which disturbed their sleep because intensive quarrying operations lasted well past bedtime. Next to noise, dust was also a leading complaint with a number of households actually attributing illnesses to the dust pollution. There were concerns about the danger from road accidents due to the

constant passage of ten-wheeler quarry trucks. The risk of rockslides and landslides was also widely feared and actual incidents were reported at sites 3, 9, and 10 where houses were damaged. Only eight households reported having received compensation from quarry operators for any damages incurred. Three of them were households whose houses were damaged by rock or landslide incidents at sites 3, 9 and 10. The lowest compensation paid was Php 3,000 or US\$ 53 for damaged walls, while the highest compensation was Php 44,000 or US\$ 786 for the destruction of an entire house. Five other households were paid compensation for damage to crops that ranged from Php 1,000 or US\$ 17 to Php 25,000 or US\$ 446.

Table 7. Profile of Households near Quarry Sites in Naga

Site No./Barangay/Sitio <sup>25</sup>	No. of household respondents	Percentage of HH w/ annual income of US\$ 1,000 and below	Percentage of HH w/agriculture as primary livelihood
1) Pangdan (Proper)	65	45 %	3.7 %
2) Cantao-an (Balisong)	18	61 %	21 %
3) Cantao-an (Magdo-oc)	20	50 %	8.4 %
4) Cantao-an (Poblacion)	17	48 %	8.2 %
5) Uling (Ventilation)	13	75 %	17 %
6) Mainit (Lower)	33	24 %	4.3 %
7) Lutac (Proper)	31	26 %	6.3 %
8) Lutac (Kalanggaman)	36	52 %	3.8 %
9) Lutac (Proper)	50	32 %	1.8 %
10) Inayagan (Pilanas)	38	53 %	4.5 %

#### 4.2.3 Measures to Mitigate the Impact of the Ten Quarry Sites in Naga

The valuation of the environmental costs associated with reclamation-related landfill quarrying was limited to the following impacts: (a) changes in flood peaks/volumes; (b) increased soil erosion and the accumulation of sediments downstream; and (c) the increased risk of landslides or mass soil wasting. A soil and water scientist<sup>26</sup> was consulted. He undertook an expert assessment of the negative impacts produced by the ten quarry sites and designed a mitigation plan. The cost of implementing the mitigation plan for each of the ten sites was used as a measure of the environmental costs associated with each site. The expert's judgment on the extent of

<sup>25</sup> A *sitio* refers to a particular neighborhood sub-grouping within a *barangay*.

<sup>26</sup> The soil and water expert who worked with the researchers on this aspect of the study was Engr. Geoffer Gonzaga of the University of San Carlos-Water Resources Center. As a civil engineer with graduate training in soil and water science, Engr. Gonzaga's research and consultancy work has included hydrology, soil conservation in watersheds, and environmental impact assessment of mining, and quarrying in Southern Philippines.

the impacts caused by each site and the mitigation measures needed was based on: (a) descriptive information discussed in the previous sections; and (b) an analysis of the quarry site topography and location using Geographic Information Systems (GIS). A combination of two measures was proposed:

1) Planting vetiver grass on exposed areas at each site – Vetiver grass, also known as *ilib*, *mora*, or *moras*, grows abundantly in some parts of the Philippines. It is regarded as an effective mechanism for soil erosion control and slope stabilization (Balbarino and Gravoso 1998; STII-DOST 2002; Truong 2004). Vetiver grass has a massive, deep, and finely-structured root system and has been used effectively in most Asian-Pacific countries (Truong 2004). Vetiver can be very effective when planted as hedges spaced every two to three meters perpendicular to a slope (Balbarino and Gravoso 1998). The use of vetiver grass is also cost-efficient compared to other conventional soil conservation methods (Truong 2004). Vetiver grass does not only conserve natural resources, but it also protects vital infrastructure projects like roads, drainage and irrigation canals, dikes, etc. (STII-DOST 2002).

2) The construction of gabion dams – Gabion dams are a commonly utilized measure for erosion control and slope stabilization in Cebu. About 12 gabion dams were constructed (1998 - 2003) within the watershed areas of Barangay Pung-ol and Sibugay, Cebu City and about 53 more are scattered within Central Cebu (CBGDP/USC-WRC 1994). These dams are made up of baskets filled with stones and are normally used for bank stabilization and other river protection measures. A gabion dam is composed of several gabion blocks overlaid on top of each other to form a stable structure. Placed across a river, these composite blocks can act as a retarding dam and increase the retention time of water in a water basin. Gabion dams function as flood control structures, as sediment traps, and as a means of increasing groundwater recharge by stabilizing the river systems (CUSW/USC-WRC 2003). Previous studies have shown that gabion dams can completely fill up with sediments after one rainy season (CBGDP/USC-WRC 1994), but they can be maintained by getting rid of any sediment regularly. The use of gabion dams and vetiver grass was highly recommended for reducing soil erosion at the ten small-scale quarries under review.

### ***Costs of Implementing Mitigation Measures at the Ten Quarry Sites***

The cost of implementing the proposed mitigation plan, excluding maintenance, for all ten sites studied was estimated at Php 9.4 million (US\$ 230,700) or an average of Php 1.3 million (US\$ 23,000) per quarry site. To maintain the effectiveness of installed gabion dams, regular maintenance is required. The cost of this maintenance, for the ten sites under review, was estimated at some Php 188,800 or US\$ 3,370. These estimates are based (with minor modifications) on actual per-unit construction and maintenance costs reported for four existing gabion dams located in Barangay Pung-ol Sibugay, Cebu City (the details are in Appendix B).

The mitigation costs reported in Table 8 were used to serve as a proxy measure for the value of negative impacts associated with landfill quarrying. Admittedly, such an approach is not without its problems. For one, it is not a technically-correct measure of the economic value of these damages. This should have been measured in terms of what people would be willing-to-pay to avoid the problems associated with the quarrying or what they would be willing to accept as compensation. Furthermore, this monetized estimate of the negative impacts of quarrying is an underestimate since it



leaves out any localized impacts on adjacent households (e.g. noise and dust pollution etc.). Finally, there are also uncertainties regarding the actual magnitude of the mitigation costs. This is because there are numerous uncertainties concerning the actual scale of the problems that need to be rectified (in terms of flood peaks/volumes, soil erosion/sedimentation and risk of landslides). Nevertheless, given the difficulties associated with implementing more technically-correct valuation methods in a developing country, such a cost-based approach was still deemed worthwhile as it can provide a reasonable approximation.

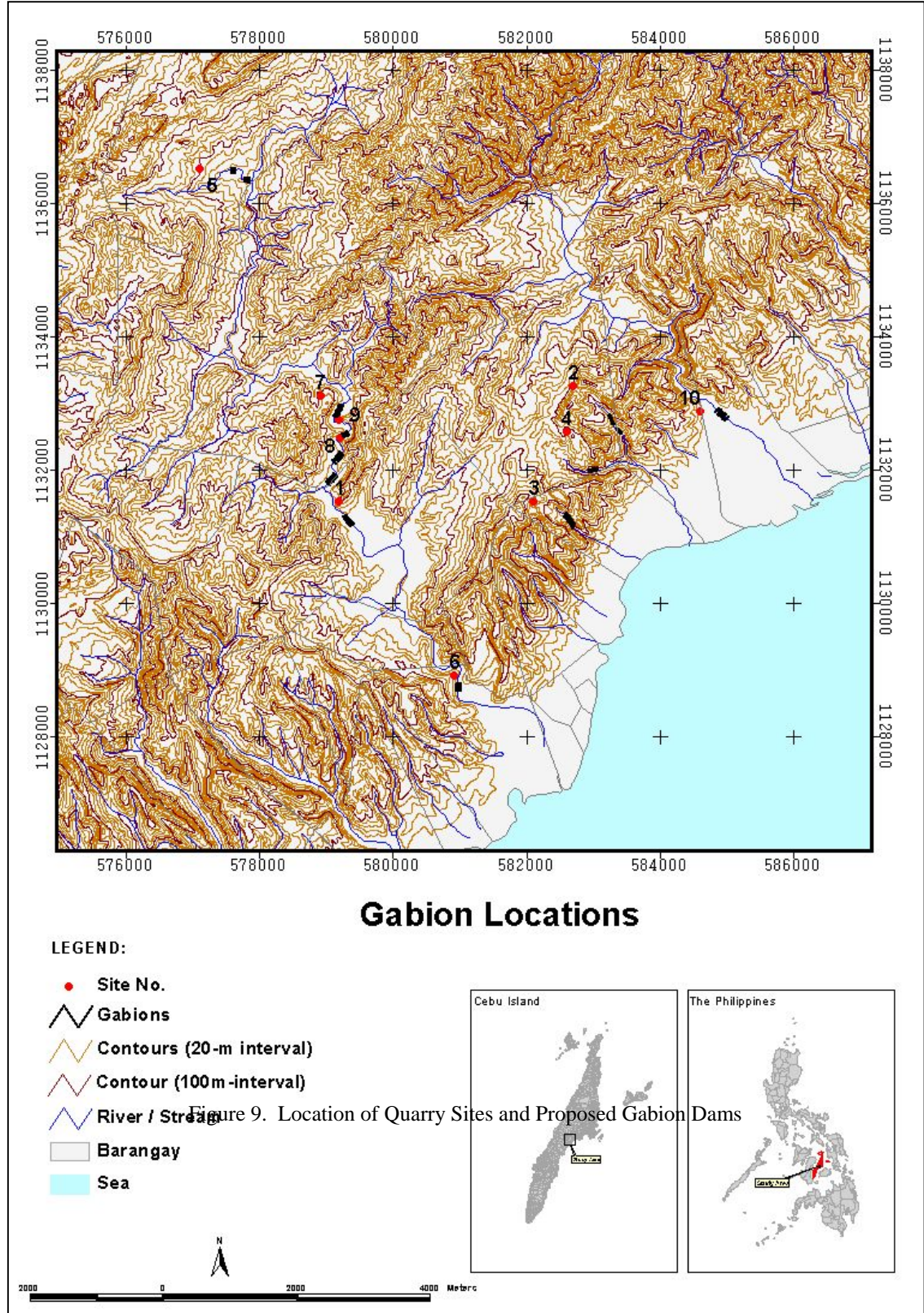


Table 8. Mitigation Costs per Site<sup>27</sup>

Site No./Location	Estimated quarry area (square meters)	No. of gabion dams required	Total cost of gabions and vetiver (in US\$)	Cost/ m <sup>3</sup> of landfill produced (in US\$)
1) Pangdan Proper	15,000	12	33,085	0.06
2) Balisong, Cantao-an	15,000	8	18,685	0.05
3) Magdo-oc, Cantao-an	30,000	8	22,971	0.09
4) Poblacion, Cantao-an	20,000	8	20,114	0.05
5) Ventilation, Uling	15,000	8	24,514	1.63
6) Lower Mainit	20,000	10	29,714	4.95
7) Lutac Proper	30,000	16	46,971	0.21
8) Kalanggaman, Lutac	19,200	16	43,882	0.17
9) Lutac Proper	15,000	16	42,685	0.16
10) Pilanas, Inayagan	38,000	16	49,257	0.16
<b>AVERAGE</b>	<b>21,780</b>	<b>--</b>	<b>33,188</b>	<b>0.75</b>

#### 4.2.4 Cost of Mitigating Impacts of CRP-related Quarrying Activities

The CRP will need approximately 170 million cubic meters of landfill material (MIIC 1997), some 13 times more than the volume used for the CSRP. As proposed by MIIC, the CRP is to be constructed within a period of 14 years at a rate of 180-190 hectares per year. This will need, on average, 12 million cubic meters of landfill annually for the entire construction period. A project of such size will require about 1,100 small-scale mountain quarries to fulfill its landfill requirements if, as suggested by the Naga case, each site produces an average of 150,000 cubic meters. That translates to around 81 new quarry sites per year. It is reasonable to expect that these quarry sites will be located within Cebu province and on neighboring islands in the region in order to minimize transport costs.

#### *Projected Mitigation Costs for CRP-related Quarrying*

Two key findings from the Naga case were used as the basis for calculating the potential mitigation costs for the damages that will result from the increase in quarrying activities necessary to supply the CRP. These were: (1) average volume of landfill production per site; and (2) average mitigation cost per site. In projecting the flow of these costs within a 30-year period, the following assumptions were made: (a) that CRP landfill will be sourced from small-scale quarries; (b) that the installation of gabion dams will be done immediately upon the start of quarry operations; and that the planting

<sup>27</sup> The computation for the annual estimated cost of mitigation through gabion dams and vetiver grass are reported in Appendix C.

of vetiver grass will be done immediately after the site is abandoned or exhausted; and (c) the maintenance of the gabion dams will be undertaken regularly for the 30 year period.

At a discount rate of 8 %, the net present value of these mitigation costs was estimated at more than Php 1 billion or around US\$ 19 million. This amount is used in this analysis as the value of the damages from landfill quarrying. However, this estimate is to be approached with caution, since it rests on the debatable assumption that the mitigation measures proposed for Naga can be applied to other quarry sites within the region. To some extent, this may be a reasonable assumption since it can be argued that the topographic, geological and hydrological makeup of Naga is typical of upland areas in Cebu.

#### 4.3 Estimated Total Environmental Costs

Table 9. Environmental Costs of the CRP

Impact	Present value (30 years, 8 % discount rate)	Valuation approach
Loss of on-site fishery	\$ 5 million	Forgone fishing rents
Loss of reef flat gleaning	\$ 3.7 million	Forgone net income
Loss of pollution control services from tidal flat	NA	NA
Loss of carbon sink functions of tidal flat	NA	NA
Impact on migratory birds	NA	NA
Damage to corals	\$ 31.6 million	Forgone recreational benefits
Damage from landfill quarrying (increased erosion rates, risk of flooding and landslides)	\$ 19.5 million	Mitigation costs
Impacts on adjacent households (temporary noise and dust pollution)	NA	NA
<b>TOTAL</b>	<b>\$ 59.8 million</b>	

The environmental cost of the CRP, in present value terms, was estimated at about US\$ 59.8 million or Php 3.3 billion. This is equivalent to 13 % of the US\$ 404 million direct reclamation development costs. Almost 86 % of the total environmental cost was attributed to damages from landfill quarrying and damage to corals. The estimated value of damage to corals, alone, made up some 53 % of the total.



## **5.0 ANALYSIS OF COSTS AND BENEFITS FOR THE CRP**

### **5.1 Economic Benefits from the CRP**

When discussing benefits from reclamation activity, it is important to distinguish between private financial benefits and economic (or social) benefits. Private financial benefits accrue to the private investor and developer who earns revenue from the sale of newly-created land. These financial gains from the sale of land are not counted as economic benefits to society as a whole because they merely represent transfers (not the creation through productive activity) of wealth. Purchases of new land may be made for either productive or speculative uses, but this does not matter from the point of view of the private investor or developer. For the CRP, it has been estimated that the net present value of these private financial benefits are positive and range from Php 41.5 billion (US\$ 741 million) to Php 81.9 billion (US\$ 1.5 billion) at 1997 prices (MIIC 1997). Note that this estimate was based on land prices before the negative impact of the 1997 Asian Financial Crisis was felt in Metro Cebu's real estate market.

On the other hand, economic benefits refer to the benefits that accrue to society as a whole and these benefits are determined by how the newly created land is used. There are as many different rationales for undertaking reclamation projects as there are possible land uses for the reclaimed land. In Metro Cebu, one of the major arguments for pursuing reclamation projects is to provide more space for industries. That is, the new reclaimed land is to be used as an industrial zone. It was argued that the space created from the new land would enable Cebu's economy to absorb or attract more industrial firms. In turn, those firms that locate on the new land would create additional jobs. From this perspective, the benefits from reclamation come from the value of additional production that results from economic activities on the new land. However, these benefits are not yet observed since the reclamation project has not yet been undertaken. So, there is considerable uncertainty concerning how large these benefits will be and when they will occur. At the same time, it is also difficult to say whether these benefits are truly incremental – i.e. whether they would not have occurred without the reclamation project.

Since, the dominant rationale for the CRP is the provision of industrial space, it is possible, to a limited extent, to examine the experience of other industrial zones located on (or even outside) a reclamation area in order to have a basis for making projections or estimates of economic benefits. The province of Cebu has 11 existing industrial zones (or special economic zones). One reclaimed area (the 300-hectare CSRP) is listed by the Philippine Economic Zone Authority as a special economic zone. Of the 160 firms who have located in such zones in Cebu province, 81 were listed as among the top-7,000 firms in the Philippines (Zosa 2004). In 2002, these 81 firms reported total revenues of Php 71.242 billion (US\$ 1.272 billion) and a corresponding profit of Php 7.182 billion (US\$ 128 million). That translates to an average annual profit per firm of Php 89 million (US\$ 1.6 million).

In Mactan Island where the proposed CRP is located, there are currently four existing special economic zones. These are: Mactan Economic Zone (MEZ) 1 (formerly known as Mactan Export Processing Zone or MEPZ 1), Mactan Economic Zone 2, Cebu Cybertown Information Technology Park, and Cebu Light Industrial Park. Table 10 summarizes basic information about these economic zones.

Table 10. Special Economic Zones in Mactan Island

Zone	Area in hectares	Year opened
1) Mactan Economic Zone 1	120	1979
2) Mactan Economic Zone 2	63	1996
3) Cebu Cybertown IT Park	No data	No data
4) Cebu Light Industrial Park	62	1998

Source: PEZA

MEZ 1 provides a rich historical example, as it is the earliest-operating zone in Cebu province (and one of the earliest in the Philippines.) It has been in operation for more than 24 years. It is considered to be one of the most successful in terms of attracting firms (mostly Japanese).

Based on the MEZ experience, where more than 78 firms are located within a 120 hectare zone, one can argue that the 2,707 hectare CRP could provide space for about 1,700 firms (if the density is the same as MEZ). However, it is not certain whether the CRP can actually attract as many firms as it can potentially accommodate, given that there are many other competing economic zones on Mactan Island and in Cebu Province that share relatively similar location advantages and that are still mostly empty. If the CRP manages to attract an average of 40 additional firms per year (i.e. almost reach its full capacity of 1,260 firms at the end of a 30-year period) with each firm earning yearly profits similar to the top-81 firms that have located in Cebu's economic zones (Php 89 million or US\$ 1.6 million), then the present value of this profit at a discount rate of 8 % for a 30-year period will range from Php 3.3 billion (US\$ 59 million) to Php 7.2 billion (US\$ 129 million).

It must be noted that the MIIC Cordova reclamation plan projected that the project would progress at about 200 hectares per year and that it would take 14 years to construct. This is key, because the higher benefit figure will only be achieved if the newly reclaimed area immediately attracts locators who begin operations as soon the first 200 hectares are completed. The above-mentioned estimated range of economic benefits can be considered as an overestimate given that the MIIC reclamation proposal only sets aside less than a quarter of the newly-created land for high-value added industrial and commercial use. It is also difficult to ascertain if these new potential industrial locators are truly additional – in the sense that do not merely relocate or shift from other areas of the region. All of these considerations point to the conclusion that the CRP's expected economic benefits will have to be extremely high to justify a reclamation project of its scale; a point we will return to in the next section of this report.

Table 11. MEZ Operations (1980-1994)

Year	No. of locators	Hectares developed	No. of employed workers
1980	No data	No data	1,185
1981	5	7.5	1,135
1982	5	7.5	1,178
1983	6	9	2,087
1984	6	9	3,836
1985	4	6	3,243
1986	8	12	3,528
1987	12	18	4,130
1988	16	24	5,763
1989	33	49.5	9,395
1990	43	64.5	11,624
1991	42	63	12,819
1992	53	79.5	15,038
1993	63	94.5	18,901
1994	78	117	26,221

Source: CPMO, EPZA

## 5.2 CBA Results and Sensitivity Analysis

Sensitivity tests on the results of the cost-benefit analysis were conducted for the following key assumptions used in the study:

### (a) Timing of economic benefit flows

Three different scenarios for the start of benefit flows from the reclamation project were constructed. These scenarios were labeled as ‘optimistic’, ‘most likely’ and ‘pessimistic’.

- Under the optimistic scenario, it was assumed that firms immediately locate and begin operations on the new land after the completion of the first 200 hectares during the first year. This means that the assumed inflow of 40 additional MEZ-type firms per year would begin immediately, even before the whole project is completed.
- Under the most likely scenario constructed, firms are assumed to start locating after the first 800 hectares is completed (or about four years after

the start of reclamation work). This reflects the strong possibility of delays and the additional time needed to undertake investment promotions.

- Under the pessimistic scenario, firms start locating eight years after the start of reclamation work (or after more than half the area is completed).

It was found that for the most likely scenario, the cost-benefit analysis for the CRP yielded a negative NPV of US\$ 370 million at an 8 % discount rate (see the cost-benefit table in Appendix A). The NPV under this scenario became even more negative at discount rates of 10 % and 12 %. When the optimistic scenario for benefit flows was used, the project still registered a negative NPV of US\$ 335 million at a discount rate of 8 %. The NPV under this scenario remained negative at discount rates of 10 % and 12 %.

Table 12. NPV for Various Benefit Scenarios and Discount Rates (million USD)

Discount Rate	Pessimistic Scenario	Optimistic Scenario	Most Likely Scenario
8%	(404)	(335)	(370)
10 %	(410)	(354)	(383)
12 %	(414)	(368)	(392)

*Note: Parentheses indicate negative values.*

#### (b) Scale of the reclamation project

A change in the scale of the reclamation project has three key consequences that may affect the results of the cost-benefit analysis: (1) a change in construction and development-related costs; (2) a change in the volume of landfill requirements, number of quarry sites required and associated adverse impacts; (3) a change in the space available for firms and other economic activities.

Analysis was conducted on the sensitivity of cost-benefit results to changes in the size of the reclamation project. This was done in terms of its ramifications on the three consequences listed above. It has been found that if the size of the reclamation area was reduced by half and the amount of landfill and the number of small-scale quarries were also halved, the estimated environmental cost of coastal reclamation would be reduced by 15%; while a reduction to a quarter of the proposed size would reduce environmental cost by 25%. The resulting NPV however remain negative but the size of the loss is reduced by more than the reduction in the project's scale (in hectares). Table 13 summarizes the results of these sensitivity tests:

Table 13. NPV for Various Project Scales (in million USD at 8% discount rate)

Scale of Reclamation Project (in hectares)
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Scenario	1354 hectares	677 hectares
Optimistic	(189)	(115)
Most Likely	(206)	(124)
Pessimistic	(223)	(133)

*Note: Parentheses indicate negative values.*

(c) Volume of recreational visitors

As discussed in Section 4.1.3, the estimate for the forgone recreational value of corals used in the cost-benefit analysis is contingent on the projected number of visitors to the area. It was found that the cost-benefit results were not highly sensitive to changes in the projected number of recreational visitors to Cordova's coral area. Table 14 summarizes the results of this sensitivity test.

Table 14. NPV for Various Volumes of Visitors (in USD at 8% discount rate)

Scenario	No. of Recreational Visitors (over a 30 year period)	
	16,449 visitors	8,224 visitors
Optimistic	(319)	(311)
Most Likely	(354)	(347)
Pessimistic	(389)	(381)

## **6.0 CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS**

This study illustrates the urgency of systematically incorporating explicit measures of environmental costs in the appraisal process of large-scale coastal reclamation projects. It shows that these costs are not trivial and that their inclusion can affect conclusions relating to the economic feasibility of such projects. Furthermore, these costs may represent large losses from the perspective of less-advantaged sectors of society. Knowing what and how large these environmental costs are can help guide the design and implementation of such reclamation projects in a way that lessens their impact.

For the case of the CRP, total environmental costs were estimated at about US\$ 59 million. It is thought that this is a lower bound figure since it does not include the various negative externalities that arise temporarily from reclamation construction. It also does not include the impact of increased levels of pollution caused by economic activities on the created land. Of the four categories of environmental costs valued in this study, damage to corals and externalities from landfill quarrying were the most significant. The avoidance of damage to the coral reef would alone reduce estimated environmental costs by more than half.

It was also found that small-scale quarrying for landfill does not necessarily translate into small-scale impacts and costs. It is also clear that the number of such small-scale quarries (more than a thousand as estimated in this study) needed to fulfill the CRP's landfill requirements may be much too large (and dispersed) for an environmental agency to consistently monitor, inspect and regulate. This would be almost certainly true if this responsibility fell solely on an under-staffed local or provincial authority. As for the forgone benefits from the loss of on-site fishery and reef gleaning, it was found that, while they would not be as large as those associated with coral damage and damages from quarrying, they would nevertheless constitute a significant livelihood loss for thousands of Cordova residents. This is especially true for barangays located on the town's southern and southeastern coast.

The findings on environmental costs have important implications for the optimal location and scale of the reclamation project, were it to proceed. The relatively large value of forgone recreational benefits from the coral reef could be avoided if the reclamation activity was not done on or near the southern or southeastern coastal area where there exists fair to good coral cover. This high environmental cost also suggests an alternative development strategy which the municipality could pursue: one that has more to do with sustainable eco-tourism than with attracting new industry. Losses from on-site fishery and reef gleaning could also be minimized by avoiding the reclamation of the southern and southeastern coastal area where the bulk of fishing and gleaning households can be found. It is also clear that, although reclamation work on a smaller scale may yield smaller economic benefit, it will have smaller landfill requirements and consequently, produce smaller external costs.

There is also something to be said regarding the mechanics of deciding the amount to be set aside for an Environmental Guarantee Fund (EGF). As discussed in the second chapter of this report, an EGF is required by Philippine law (Department Administrative Order No. 37 Series of 1996) for projects which are deemed by the

DENR to pose significant public risk or entail rehabilitation/restoration expenses. DAO 96-37 states that a significant public risk may be presumed if the following conditions exist: (a) the presence of toxic chemical and hazardous as defined in Republic Act No. 6969; (b) the extraction of natural resources that requires rehabilitation or restoration; (c) the presence of structures that could endanger life, property and the environment in case of failure; or (d) the presence of processes that may cause pollution as defined under previous pollution laws.

As enumerated in the DAO 96-37 Procedural Manual, an EGF may be used for the following purposes: (a) the immediate rehabilitation of areas affected by damage to the environment and the resulting deterioration of environmental quality as a direct consequence of project construction, operation and abandonment; (b) the just compensation of parties and communities affected by the negative impacts of the project; (c) the conduct of scientific or research studies that will aid in the prevention or rehabilitation of accidents and/or environmental damages; or (d) contingency clean-up activities, environmental enhancement measures, damage prevention program, and social equity measures. However, there is no explicit provision under DAO 96-37 requiring the valuation of potential impacts. The EGF is determined through negotiations between the proponent and the DENR. For there to exist a more rational and transparent process for setting the EGF, we recommend that the valuation of impacts be explicitly required.

If the EGF amount is to be based on the explicit valuation of environmental costs, the study's findings suggest that, in the case of the CRP, it needs to be in the area of almost US\$ 60 million. This amount would cover compensation for lost income from fishing and gleaning as well as the costs of mitigating the impacts of landfill quarrying activities. Furthermore, part of the amount may also be invested in the development and management of the town's coral reef.

Finally, the comparison of costs and benefits show that the economic desirability of reclamation activity is greatly dependent on how well the reclamation area is utilized after completion. The key is to make sure that the newly reclaimed land is immediately used for productive and not speculative uses and that no more is reclaimed than is truly needed for the purpose of enlarging urban space.

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## APPENDIX A

**Benefit-Cost Table (Most Likely Scenario at 8%)**

<b>COSTS (million US\$)</b>		<b>Years</b>				
	<b>0-5</b>	<b>6-10</b>	<b>11-15</b>	<b>16-20</b>	<b>21-25</b>	<b>26-30</b>
1) Environmental Costs						
Loss of on-site fisheries	1.88	1.99	2.16	2.70	3.40	4.30
Loss of reef flat gleaning	1.20	1.31	1.67	2.13	2.72	3.47
Damage to corals	6.49	11.16	17.77	23.86	27.53	28.99
Damages from landfill quarrying	12.03	10.51	7.26	1.91	1.91	1.91
2) Development Costs						
Construction Costs	280.55	245.66	88.86	0	0	0
Operation & maintenance	0	0	0	3.18	3.18	3.18
<b>BENEFIT (million US\$)</b>						
1) Net value of additional production	3.41	28.38	56.76	85.14	111.25	140.20
<b>Net present value (NPV) at 8 per cent</b>	<b>-370.17</b>					

## APPENDIX B

### Actual Construction Costs of Four Gabion Dams in Barangay Pung-ol Sibugay, Cebu City

<b>GABION DAM 1:</b>		Width (meters): 3 Blocks: 13				
		<b>pieces</b>	<b>unit</b>	<b>price/unit</b>	<b>total</b>	<b>price per gabion block</b>
Labor		13	gabion blocks	450.00	5,850.00	29.73
stones		22	cubic meters	450.00	9,900.00	50.30
interlink wire		9	rolls	400.00	3,600.00	18.29
cement		3	bags	110.00	330.00	1.68
	<b>SUBTOTAL</b>				<b>19,680.00</b>	1,513.85
<b>GABION DAM 2:</b>		Width (meters): 3 Blocks: 13				
		<b>pieces</b>	<b>unit</b>	<b>price/unit</b>	<b>total</b>	<b>price per gabion block</b>
Labor		13	gabion blocks	450.00	5,850.00	29.73
stones		22	cubic meters	450.00	9,900.00	50.30
interlink wire		9	rolls	400.00	3,600.00	18.29
cement		3	bags	110.00	330.00	1.68
	<b>SUBTOTAL</b>				<b>19,680.00</b>	1,513.85
<b>GABION DAM 3:</b>		Width (meters): 4 Blocks: 17				
		<b>pieces</b>	<b>unit</b>	<b>price/unit</b>	<b>total</b>	<b>price per gabion block</b>
Labor		17	gabion blocks	450.00	7,650.00	29.49
stones		29	cubic meters	450.00	13,050.00	50.31
interlink wire		12	rolls	400.00	4,800.00	18.50
cement		4	bags	110.00	440.00	1.70
	<b>SUBTOTAL</b>				<b>25,940.00</b>	1,525.88
<b>GABION DAM 4:</b>		Width (meters): 5 Blocks: 21				
		<b>pieces</b>	<b>unit</b>	<b>price/unit</b>	<b>total</b>	<b>price per gabion block</b>
Labor		21	gabion blocks	450.00	9,450.00	29.35
stones		36	cubic meters	450.00	16,200.00	50.31
interlink wire		15	rolls	400.00	6,000.00	18.63
cement		5	bags	110.00	550.00	1.71
	<b>SUBTOTAL</b>				<b>32,200.00</b>	1,533.33
<b>TOTAL</b>					<b>97,500.00</b>	

## APPENDIX C

### Estimated Construction and Annual Maintenance Cost of Gabion Dams for Ten Quarry Sites in Naga, Cebu

Site No	Location	No of Gabion	No of Gabion Blocks per Dam	No of Gabion Blocks	Unit Cost	Cost	Yearly Maintenance
1	Proper, Pangdan	12	56	672	1,500.00	1,008,000.00	20,160.00
2	Balisong, Cantao-an	8	42	336	1,500.00	504,000.00	10,080.00
3	Magdooc, Cantao-an	8	42	336	1,500.00	504,000.00	10,080.00
4	Poblacion, Cantao-an	8	42	336	1,500.00	504,000.00	10,080.00
5	Uling	8	59	472	1,500.00	708,000.00	14,160.00
6	Lower Mainit	10	56	560	1,500.00	840,000.00	16,800.00
7	Proper, Lutac	16	56	896	1,500.00	1,344,000.00	26,880.00
8	Kalanggaman, Lutac	16	56	896	1,500.00	1,344,000.00	26,880.00
9	Prper, Lutac	16	56	896	1,500.00	1,344,000.00	26,880.00
10	Inayagan	16	56	896	1,500.00	1,344,000.00	26,880.00
<b>Total</b>						<b>9,444,000.00</b>	<b>188,880.00</b>

Note: 1 Gabion Block = 0.9m x 0.9m x 2.0m = 1.62m<sup>3</sup>

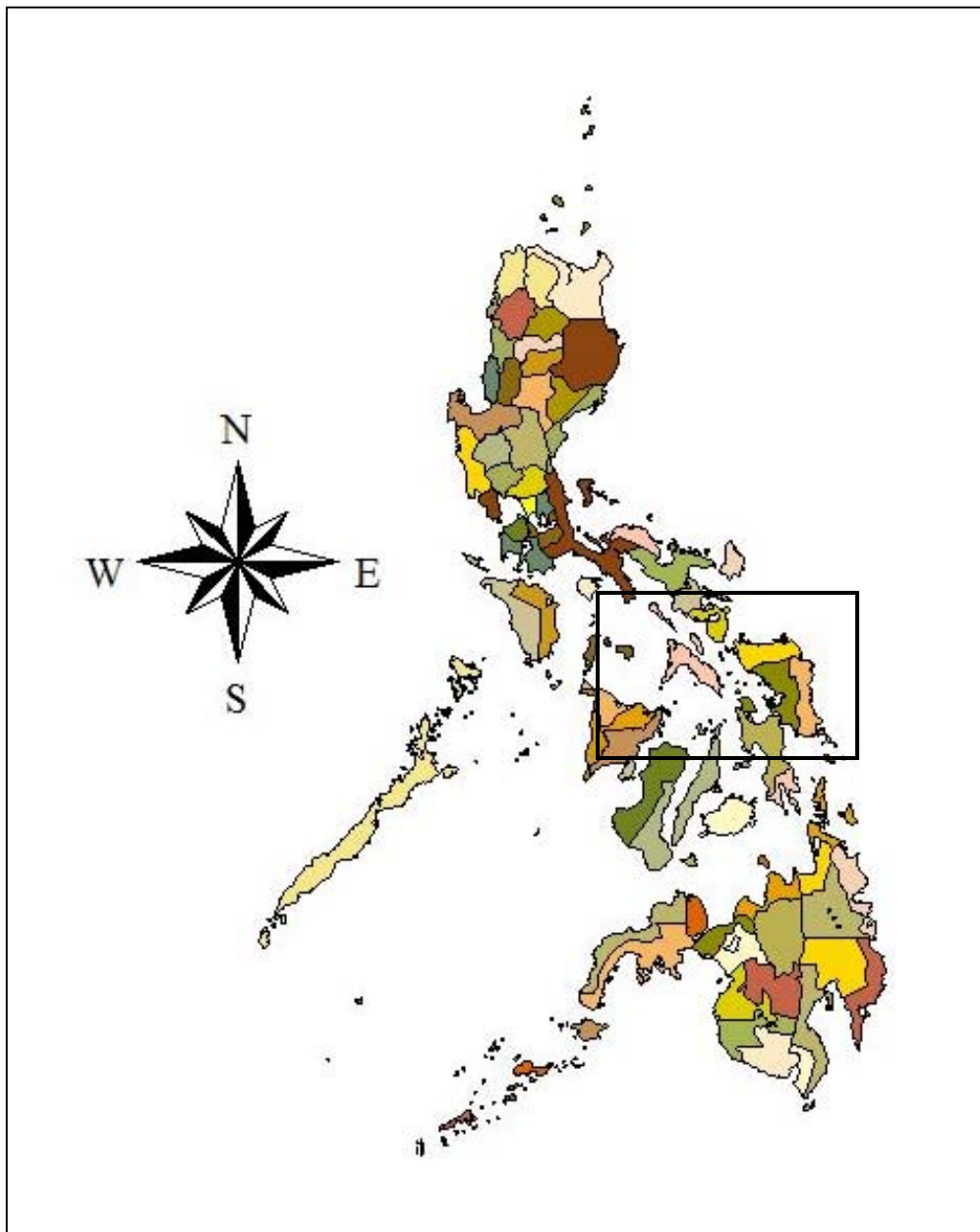
## APPENDIX D

### Estimated Cost of Initial Planting and Maintenance of Vetiver Grass for Ten Quarry Sites in Naga, Cebu

Site No	Location	Mine area (m <sup>2</sup> )	Unit Cost per m <sup>2</sup> Area	Cost	Yearly Maintenance	Total
1	Proper, Pangdan	15,000	16.00	240,000.00	4,800.00	384,000.00
2	Balisong, Cantao-an	15,000	16.00	240,000.00	4,800.00	384,000.00
3	Magdooc, Cantao-an	30,000	16.00	480,000.00	9,600.00	768,000.00
4	Poblacion, Cantao-an	20,000	16.00	320,000.00	6,400.00	512,000.00
5	Uling	15,000	16.00	240,000.00	4,800.00	384,000.00
6	Lower Mainit	20,000	16.00	320,000.00	6,400.00	512,000.00
7	Proper, Lutac	30,000	16.00	480,000.00	9,600.00	768,000.00
8	Kalanggaman, Lutac	19,200	16.00	307,200.00	6,144.00	491,520.00
9	Prper, Lutac	15,000	16.00	240,000.00	4,800.00	384,000.00
10	Inayagan	38,000	16.00	608,000.00	12,160.00	972,800.00
<b>Total</b>				<b>3,475,200.00</b>	<b>69,504.00</b>	<b>5,560,320.00</b>

## APPENDIX E

### Map of the Philippines





## APPENDIX F

### Location Map of Metro Cebu

